FLIGHT

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DIARY OF CURRENT AND FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in this list—

1929.

July 16-27.... 7th International Aero Exhibition, Olympia.
July 19 .... Civil Aviation Ball, at Grosvenor House, Park Lane
July 20 .... Air Garden Party at Heston Air Park, Hounslow
July 25 .... Bleriot Cross-Channel Flight Anniversary Fete, Calais.
July 28 .... International Flying Meeting, Sweden.
Aug. 1-14.... French Light Plane Meeting, Orly.
Aug. 15 .... International Balloon Race, Poland.
Sept. 6-7 .... Schneider Trophy Race, Solent.
Sept. 10-20 Aero Club de France Meeting, Le Baule.
Oct. 1 .... Gordon-Bennett Balloon Race, St. Louis, U.S.A.
Oct. 31 .... Guggenheim Safe-Aircraft Competition Closes.

EDITORIAL COMMENT

WE very much wonder if, any day this summer, whether at Ascot, Wimbledon, Henley, Aldershot, or elsewhere, has given as great an amount and as high a degree of pleasure as was given by the Royal Air Force Display last Saturday. Something between 100,000 and 150,000 people saw the English summer at its most ideal—blazing sun, blue sky, and a deliciously cooling breeze—and they also saw young Britons doing what no one else can do so well. Disciplined individuality might be given as a description of our chief national characteristic, whether we be English, Scottish, Welsh, or Ulstermen. Nowhere is this characteristic more strikingly displayed than in the flying of the Royal Air Force. Even a sergeant-major of the Guards would admire the results of discipline, as shown in the formation flying, of which the best example seemed to us to be the low bombing by No. 12 Bomber Squadron and No. 3 Fighter Squadron. It was also very well expressed in what the programme called individual aerobatics, when two pilots approached the aerodrome from different directions and each performed the same manœuvre simultaneously. For a moment we were inclined to think that individuality had got rampant in the crazy flying, until we noticed that both pilots were performing in the same style, and that that style was quite different from the crazy flying of Noakes and Longton, who again were quite unlike each other.

The Royal Air Force Display

It is easy, and it is true, to say that the high standard of performance set up in previous years was well maintained at this Display. But we conceive it to be the duty of an aviation paper to be as hyper-critical as possible. When we write that we have no criticisms to make, we want those who have offered themselves for criticism to know that we mean literally just what we say; and this feeling will not prevail unless we invariably point out even details where we consider that improvement is possible. On this occasion, we have some remarks to make, and they concern a novelty in air force tactics, as exemplified in the attack on an encampment

by a fighter squadron. In this case, we are not in any way criticising the performance of No. 41 Fighter Squadron, which carried out the attack. It is a magnificently trained squadron, and year after year its performances in displays and on air exercises invariably arouse our admiration. On this occasion, we watched its manœuvres very carefully, and are convinced that it could hardly have done better than it did in the circumstances. What we criticise is this. In previous years, fighter squadrons have attacked ground targets by flying round them in a circle, from which one machine was always diving on to the target and firing or bombing. How they escaped collisions was a marvel, but the skill with which this manœuvre was always carried out was remarkable. This year, the attack was made, not by single machines in rotation, but by flights. We have heard the opinion expressed that when a flight is diving and using its machine guns, only the leader can take deliberate aim, while the other two pilots must give their main attention to keeping formation.

However this may be, the programme explained that "The easiest target that low-flying aircraft offers to ground machine guns is when it is flying away. Converging bombing is therefore designed with the object of maintaining continuous attacks on the target from rapidly-changing directions. Whilst one flight is leaving the target, the next flight is making its attack and covering the retirement of the first flight." We watched the operation with this explanation firmly fixed in our minds, and noticed that there were several quite perceptible intervals of time in which the target was not under fire at all, and during these, the surviving ground gunners would have had a clear and unhampered aim at the flight, which was climbing out of the way after delivering its attack. In fact, it appeared that a flight was a unit too slow in wheeling round to be able to make sure that each retreat was covered by fire. The individual machine is, in the nature of things much quicker. We repeat that we do not think any squadron could have been smarter in carrying out the manœuvre than No. 41 F.S. was. The fault lay with the tactics, not with the execution. Really effective covering fire is even more important in the case of aircraft than in the case of infantry, for fire from the air must always be plunging fire, and so less effectual than the grazing fire of infantry fighting infantry. In other words, ground gunners have a good chance of surviving a number of attacks by flights of aircraft, and so have a chance of retaliating with effect. It will be interesting to see whether these tactics are adhered to next year.

In another event we should like to congratulate the air force on its resourcefulness. It is not, we imagine, usual for a man to carry more than one parachute. But special risks attend a display of simultaneous parachuting, and the authorities were ready for them. When two parachutes collided in mid-air, and the ropes became entangled, though the rate of falling was not perceptibly increased, still, for a moment, everyone felt a trifle anxious. But like a flash, one man released an emergency parachute, and all danger immediately vanished. It was a good object lesson in minimising risks.

Everything else went off according to plan and to programme, though it was evident that the wind upstairs was a good deal more boisterous than it was in the enclosures, and keeping formation required more skill and attention than on a perfectly calm day.

We may conclude by welcoming the first appearance at a Display of the Bulldog as a standard service machine. We may also congratulate No. 3 F.S., which for so long had to put up with Woodcocks after other squadrons had received Gamecocks and Siskins, on being the first unit to receive the Bulldog. The new fighter was not given a chance to show off its paces, possibly for some sufficiently good reason, but we look forward to seeing something really startling from it in next year's Display.

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INVESTITURE AT ST. JAMES'S PALACE

HIS ROYAL HIGHNESS the Prince of Wales held an Investiture on July 9 at St. James's Palace, when the following were amongst those introduced into the presence of His Royal Highness and invested by him, on behalf of the King, with the respective Divisions of the Orders into which they have been admitted :—

Order of the Bath

Companions:—Military Division: Air Commodore Cyril Newall, C.M.G., C.B.E. Civil Division, Mr. Christopher L. Bullock, C.B.E., Assistant Secretary, Air Ministry.

Order of St. Michael and St. George

Knights Grand Cross: Sir John Cadman, D.Sc., K.C.M.G., and Lieut.-Colonel Sir Maurice P. A. Hankey, G.C.B.

Knight Commander: Lieut.-Colonel Sir Francis H. Humphrys, G.C.V.O., K.B.E., C.I.E.

Order of the British Empire

Officers: Wing Commander Edgar Huntley, M.B., B.S., R.A.F., and Squadron Leader Robert Oxland, R.A.F.

Members: Sergeant-Major Charles Goodchild, R.A.F., Sergeant-Major Francis Parker, R.A.F., and Sergeant-Major Charles Turner, R.A.F.

The Prince of Wales, on behalf of His Majesty, then conferred decorations as follows :—

The Distinguished Flying Cross

Received a Second Bar :—Squadron-Leader Harold Whistler, R.A.F.

The Air Force Cross

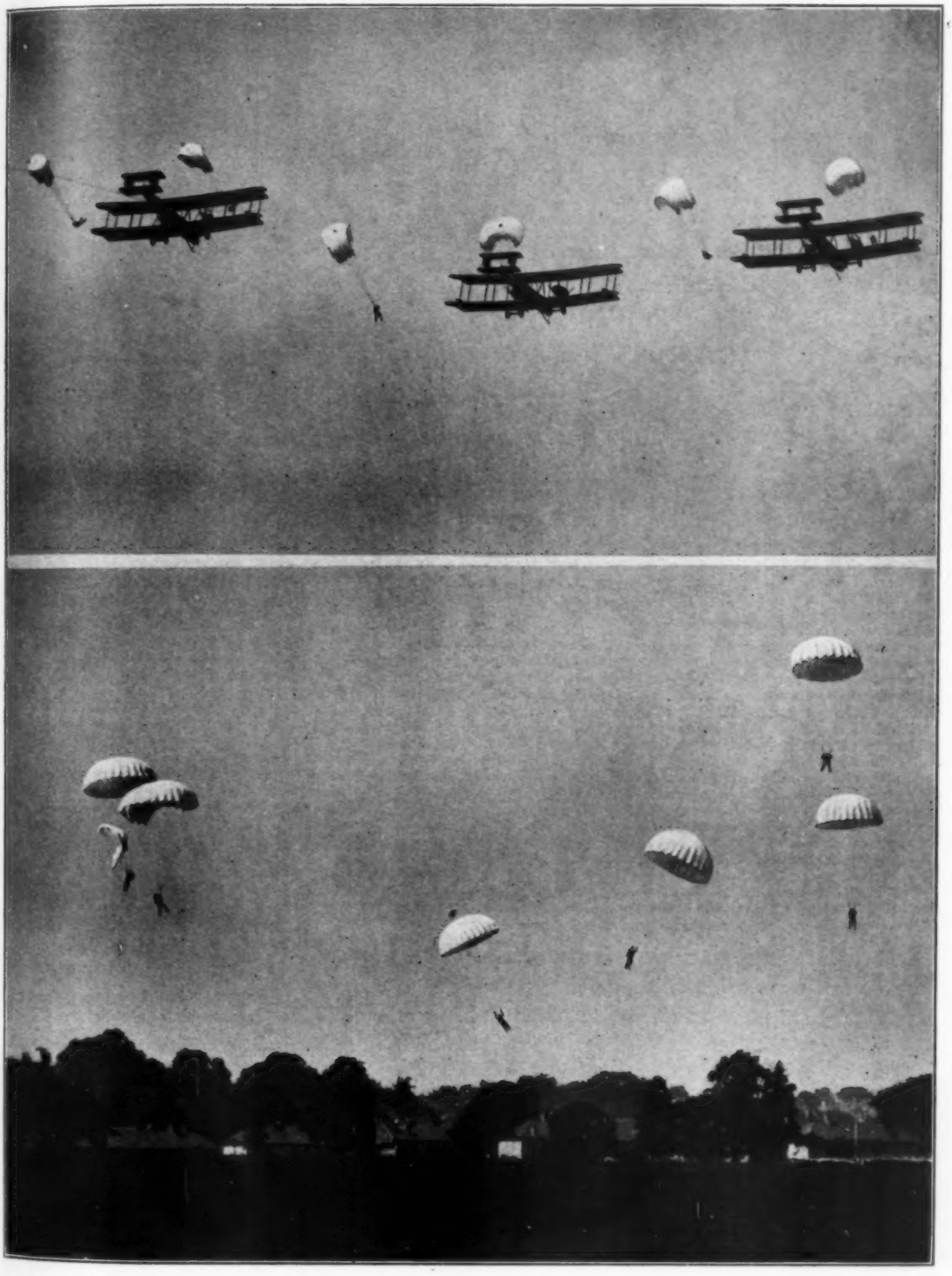
Flying Officer Ardley Pickering, R.A.F., and Flying Officer Claude Trusk, R.A.F.

The Medal of the Military Division of the Most Excellent Order of the British Empire
For Gallantry

Flying Officer Walter Anderson, R.A.F., and Corporal Thomas McTeague, R.A.F.

Pilot Officer H. A. Constantine, while flying an aeroplane off Leysdown on December 10, 1928, crashed into the sea, about 200 yards from the shore. Corporal McTeague and Flying Officer Anderson immediately entered the sea from the shore and swam to his assistance. The weather was bitterly cold, an on-shore wind was blowing, and the sea was fairly rough. Constantine, fully clothed and suffering from injuries and shock, commenced to swim ashore, but was in a state of collapse when the first swimmer (McTeague) reached him. McTeague, though exhausted himself, supported him until the arrival of Anderson, and Constantine was then brought to safety (this involving swimming for a distance of about 100 yards) by their combined efforts. The extremely prompt and timely action of Anderson and McTeague, and the gallantry and persistence they displayed, undoubtedly saved the life of Constantine.

TENTH R.A.F. DISPLAY



EVENT 3: PARACHUTE DESCENTS: A thrilling demonstration by the Parachute Section of the Home Aircraft Depot. Above, six airmen are seen leaving the three Vickers Vimy machines. Below, they are nearing the ground; the two on the left collided, and one released another, emergency, 'chute (which can be seen opening) and thus avoided an accident. ("FLIGHT" *Photos.*)

The 10th. ROYAL AIR FORCE DISPLAY

TAKING it all round, the tenth Royal Air Force Display, which was held at Hendon, on Saturday last, July 13, was perhaps the "biggest" yet produced. Each year one feels that the zenith has been reached in the quality of the programme, yet when the next Display comes along, one leaves the aerodrome at the conclusion of the six-hours' "entertainment" as thrilled as ever and still more impressed.

Although most of the items in this year's programme were old ones, there was a "finish" about them, and something in the way they were served out, that made them as interesting, perhaps even more so, as before. Always good, the organisation this year was excellent—every detail in the programme being carried out with clockwork precision and regularity, and without a single serious mishap. The "stage-managing" of the "performers" was, in fact, of that same high standard obtaining in those wonderful Aldershot Tattoos.

Another point which made Saturday's Display remarkable, was that the morning's events, apart from the main programme (which commenced at 3 p.m.) formed quite an excellent Display in themselves, and, finally, there was, this time, a vast crowd to see them, people having arrived at the aerodrome in exceptionally large numbers at quite an early hour. Thus it was, that by 3 p.m., the attendance (and people were still pouring in) was, in our estimation, even then a record one.

As on previous occasions, a most distinguished gathering was present, and the smart and gaily-coloured dresses rivalled Ascot. In the absence of H.M. the King, H.R.H. The Prince of Wales, accompanied by the Duke and Duchess of York, attended. Among those in the Royal Enclosure were the King of Spain and The Infante Don Alfonso, the Raja of Kalsia, the Maharaja of Rajpipla, the Maharaja of Rewa—Indian Ruling Princes—the Sultan of Johore. Members of the House of Lords and House of Commons, including Lord Thomson, Lord Parmoor, the Prime Minister, Mr. Philip Snowden, Mr. J. H. Thomas, etc., were also present.

Representatives of the various Colonies, Ambassadors, Naval, Military and Air Attachés of some fifteen foreign countries, the British and Foreign Aircraft Industry, were all in attendance. The R.A.F. and Air Ministry were represented, amongst others, by Marshal of the Royal Air Force Sir Hugh Trenchard (who received the Prince of Wales), Air Vice-Marshals Sir Geoffrey Salmond, Sir Philip Game, Sir John Steel, F. R. Scarlett, C. Longcroft, Air Commodores E. L. Gerrard, T. C. Higgins, C. R. Samson, A. M. Longmore, etc., Air Vice-Marshal Sir Sefton Brancker, Mr. C. R. Brigstocke, Mr. H. E. Wimperis, Lieut.-Col. W. S. Outram, etc. The crew of the *Southern Cross*, just arrived from Australia, were also present.

As regards the weather, this was ideal—a real, "pre-war" English July summer's day, with a cloudless blue sky, and a refreshing wind (which, while perfect for those on the ground, was, perhaps, a little trying up above). On the other hand, the absence of cloud almost certainly added sore eyes and aching heads to the stiff necks of the majority of spectators when they got home!

The Morning Programme

Event A. Reserve Officers' Race.—The first event in the morning began at noon. It was a race for officers of the R.A.F. Reserve. Four competitors represented the four Reserve Schools, each of which is operated by an aircraft company. The following officers completed; Flying Officer F. Ellam (De Havilland Reserve School); Flying Officer E. V. Culverwell (Bristol Reserve School); Flying Officer R. N. Riddell (Armstrong Whitworth Reserve School) and Flying Officer H. T. Messenger (North Sea Aerial and General Transport Reserve School, Brough.). A course of 28 miles was flown in two laps on Avro-Lynx aircraft; and the race was like a steady procession, with the machines maintaining throughout a sort of staggered formation two leading two.

As far as one could observe, their positions never changed until they approached the finishing line, when the fourth machine shot ahead of the third machine. The winning pilot finished with the lead that he seemed to have held soon after the start. He was Flying Officer H. T. Messenger of the Brough Reserve School. Second place was won by Flying Officer E. V. Culverwell of the Bristol School.

Event B. Individual Aerobatics:—Flying Officer J. Clarke and Sergeant T. W. Morton, both of No. 29 (Fighter) Squadron, gave an exhibition of individual aerobatics on Armstrong Whitworth "Siskins" (Jaguars). They made a perfect formation ascent, wing-tip to wing-tip, circled the aerodrome as though one machine, then separated and began their manœuvres in opposite directions, beginning each with a long dive towards each other.

One dive was followed by the zoom and flick loop, another dive ended with tight loops, another with slow rolls, and the machines also crossed each other's path whilst slowly rolling. Their manœuvres, although made at opposite boundaries of the aerodrome, were accurately timed for the most part, and when there was not quite perfect synchronisation it was only a matter of a slight difference in the speed of each manœuvre. One machine might come out of the roll a little faster than the other. The pilots were particularly skilful at diving past each other over the same spot. It will be remembered that they were runners up in the eliminating competition for Fighter Squadrons which was held recently.

TENTH ROYAL AIR FORCE DISPLAY: A portion of the vast crowd, which was probably a record one, being estimated at from 100,000 to 150,000.

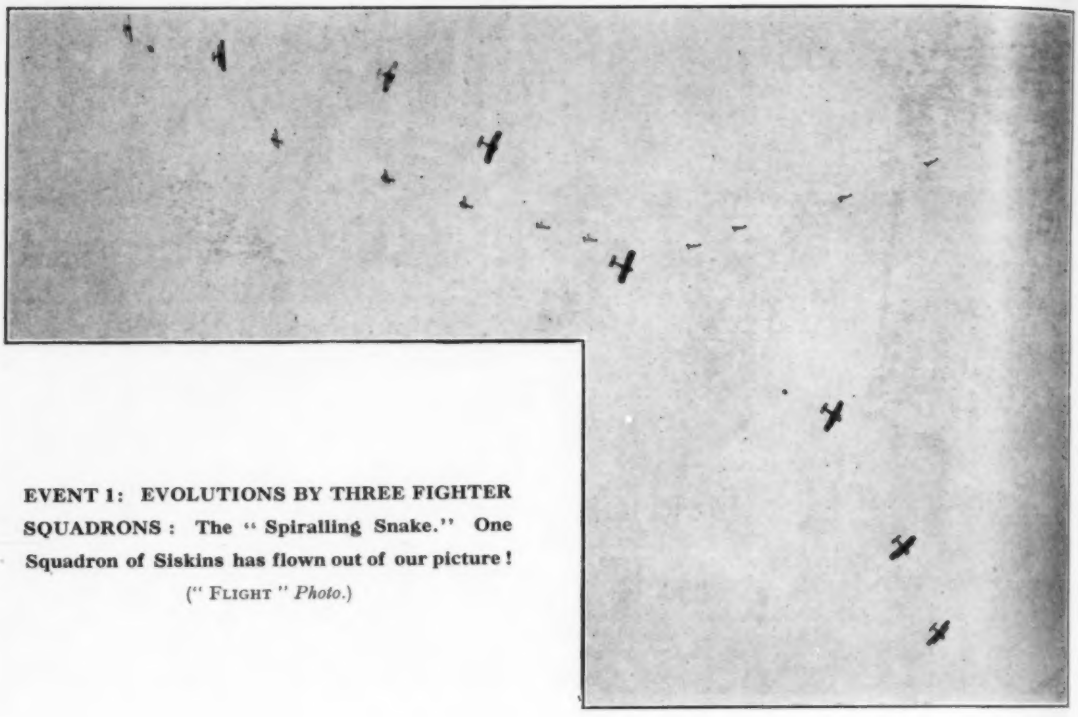
at Northolt. Flying Officer J. Clarke is the designer of the new light 'plane called the Clarke "Cheetah."

Event C. Slow Flying.—This event was given by Squadron Leader D. S. Don, of No. 24 (Communication Squadron) on a Gipsy-Moth fitted with Handley Page slots. He placed his manœuvres excellently. The ailerons were shown flapping rapidly whilst the machine was in stalled flight. They could be seen by everybody. Stalled descents parallel to the enclosures with very little forward speed and again demonstrating plenty of lateral control were also skilfully executed. Sqdr.-Ldr. Don included exhibitions of the rapid manœuvrability of the light 'plane. He performed very low tight loops and zoomed the machine like a fighter. This officer is usually the pilot to the Prince of Wales, and the Prince would have been particularly interested in this exhibition had he been present in the morning.

Event D. Relay Race.—After this event came the final of a relay race for Cadre and Auxiliary Squadrons over a distance of approximately fourteen miles. Each squadron used Avro-Lynx aircraft. The winning squadron was No. 601 (County of London) and their time taken for the course was 29 mins. 25 secs. No. 503 (Bombing) Squadron, was second. These squadrons are commanded by Sqdn.-Ldr. Lord Edward Grosvenor and Wing Commander the Hon. L. J. E. Twisleton-Wykeham-Fiennes respectively.

Event E. Artillery Observation.—This educational item of Royal Air Force practice, which began promptly at 1.25 p.m., was particularly successful. An arrangement which gave the spectators a very close interest in the manœuvre was the usual broadcasting of the observation pilot's messages. His morse was very steady and slow, and could be easily read by those familiar with the code. One must also mention the very realistic broadcast of the "screeching shells." An Armstrong Whitworth "Atlas" was the

EVENT 1: EVOLUTIONS BY THREE FIGHTER SQUADRONS: Twenty-Seven Siskins of Nos. 1, 25, and 43 Squadrons "left-wheel" in Flights Astern. ("FLIGHT" *Photo.*)



EVENT 1: EVOLUTIONS BY THREE FIGHTER SQUADRONS: The "Spiralling Snake." One Squadron of Siskins has flown out of our picture!

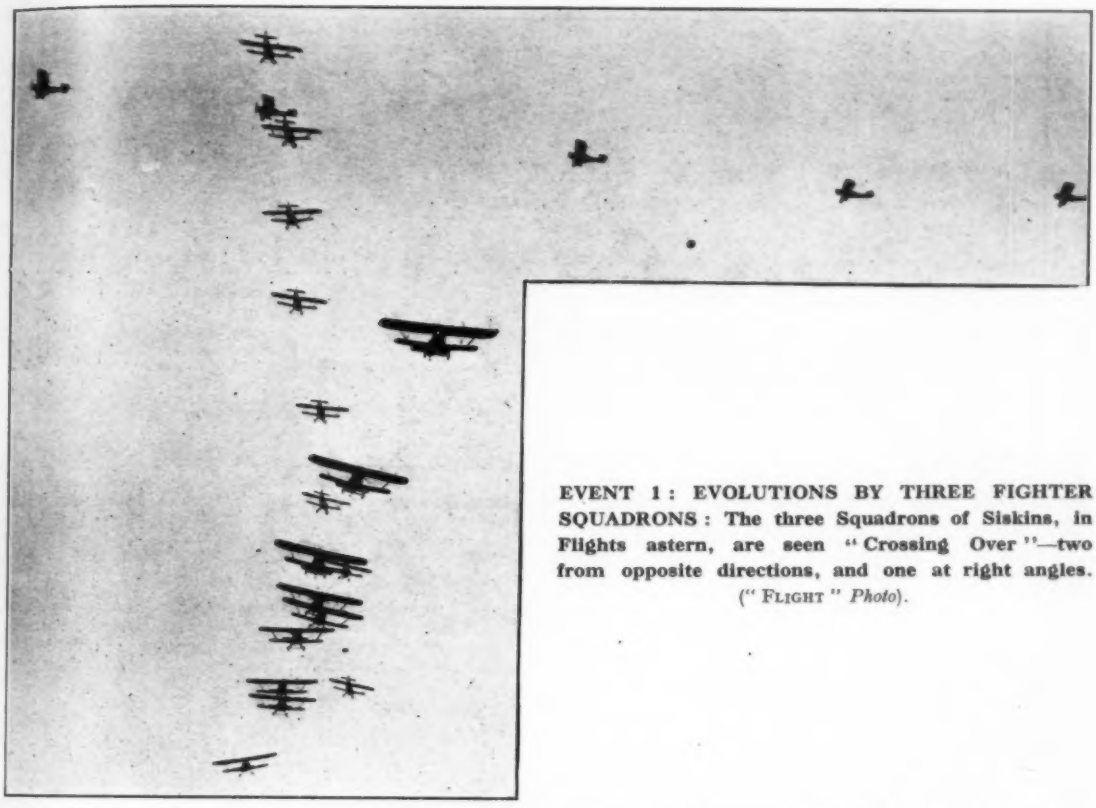
("FLIGHT" *Photo.*)

observation machine, flown by Flying Officer P. N. R. Hallward, No. 13 (Army Co-operation) Squadron. The manœuvre began with the approach of this machine and the reporting by the pilot of an ammunition column of lorries. Under his wireless direction gunfire was opened on the column. A breakdown occurred among the lorries, and as the firing became more accurate the defective lorries were deserted by the column.

Under the wireless corrections of the observation machine the gunners concentrated fire on the target, but suddenly an enemy fighter appeared in the sky (Bristol Bulldog (Jupiter) flown by Flt.-Lt. J. L. Airey, of No. 3 (Fighter) Squadron), and attacked the observation machine. After a close fight the Atlas vanquished the intruder which dived out of control, belching smoke with very realistic effect. Then the target was successfully demolished by gunfire, and the observation machine continued its patrol peacefully.

Event F. Headquarters Race.—This was a handicap race of approximately twenty-eight miles, open to one officer from the Air Ministry and each Headquarters of Home Commands, for a cup presented by H.R.H. The Duke of York. The following pilots and machines took part:—Flt.-Lt. W. J. Jones (Gloster Gamecock), Air Ministry; Sqdr.-Ldr. H. G. Bowen (Gloster Grebe), Air Defence of Great Britain;

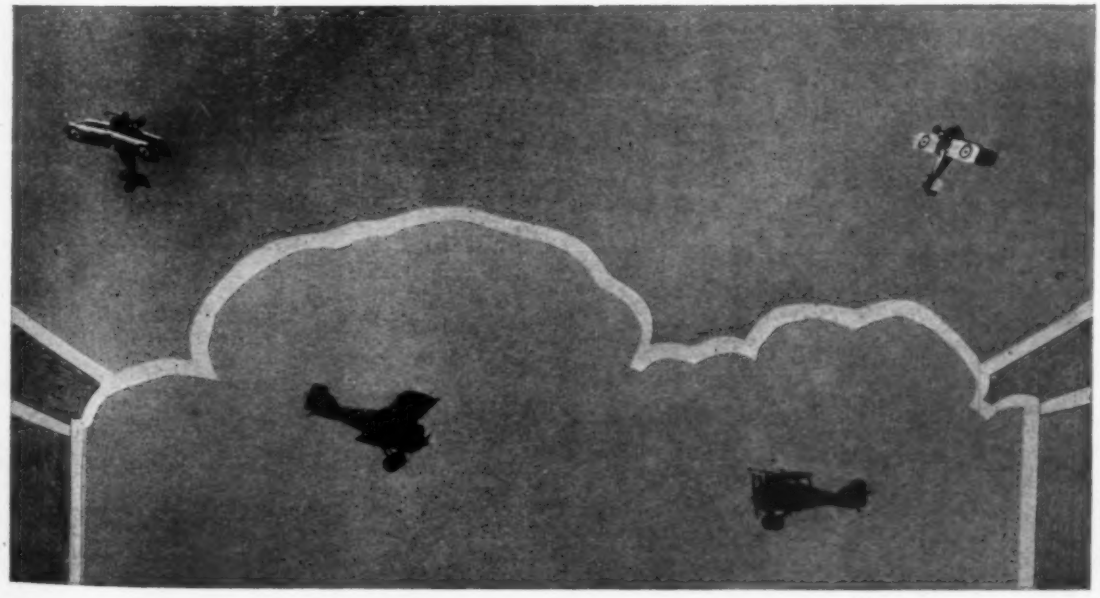
EVENT "E" (MORNING): ARTILLERY OBSERVATION: Shells from a battery of Artillery bursting around stranded ammunition lorries. An Armstrong-Whitworth Atlas, of the Army Co-operation Squadron, overhead and out of the picture, directs the fire of the battery by wireless (these messages were broadcast, and heard by the spectators). ("FLIGHT" *Photo.*)



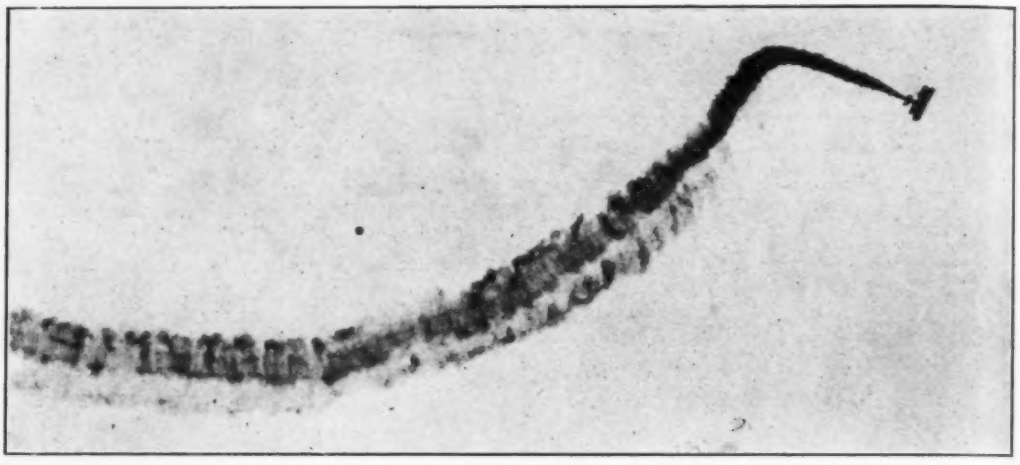
EVENT 1: EVOLUTIONS BY THREE FIGHTER SQUADRONS: The three Squadrons of Siskins, in Flights astern, are seen "Crossing Over"—two from opposite directions, and one at right angles. ("FLIGHT" *Photo*).

Flt.-Lt. E. F. Waring (Fairey Flycatcher), Coastal Area; Flt.-Lt. S. D. Macdonald (Fairey III F), Fighting Area; Flt.-Lt. D. S. Earp (Gloster Gamecock, Inland Area; Wing Commander W. A. McClaughry (Bristol Fighter), Wessex Bombing Area; Flt.-Lt. R. A. George (Armstrong Whitworth Siskin), Cranwell; and Flt.-Lt. C. D. Adams (Siskin), Halton.

The Bristol Fighter started first, followed quickly by the Flycatcher, then came the others in rapid succession, with the two Gamecocks scratch, if anything. After the first lap of fourteen miles had been covered, the Bristol Fighter had maintained its start, but two Siskins were rapidly overhauling it, followed by the Flycatcher and Grebe. At the turning points some competitors lost much ground, possibly due to the



EVENT 2. INDIVIDUAL AEROBATICS: This was given by F./O's. C. H. Jones and H. A. Purvis (No. 23 Fighter Sq.) on Gloster-Jupiter Gamecocks. After diving towards each other (as shown below), they zoomed upwards and simultaneously executed the same evolution (as shown above). ("FLIGHT" *Photos.*)



EVENT G. SERVICE SKYWRITING": One of the two Gloster Grebes which took part in an "illuminating" display of Individual Aerobatics, assisted by the Savage Skywriting apparatus. It is seen, with its column of orange smoke, executing a half-roll. ("FLIGHT" *Photo*).

danger of overcrowding. The second and last lap was finished by Flt.-Lt. C. D. Adams, of Halton, on the Siskin (Jaguar) with a good lead over the second machine, which was also a Siskin (Jaguar) flown by Flt.-Lt. R. A. George, M.C., of Cranwell.

Event G. Individual Aerobatics.—Perhaps the most impressive of the morning events was the display of Individual Aerobatics by two pilots of the Aeroplane and Armament Experimental Establishment—Flight-Lieuts. J. Bradbury and G. E. N. Guest—on Gloster-Jaguar Grebes, in which coloured smoke, produced by the smoke apparatus supplied by Major J. Savage, of Skywriting, Ltd., was employed to emphasize the various manœuvres.

Although this "turn" was an old one, the use of the coloured smoke gave it an entirely new and extremely fascinating aspect. The rolling columns of golden orange—changing to lemon yellow—heading by the bright red, or blue, machines, looked very beautiful, indeed, against the cloudless, blue sky—a blue that changed from pale azure to deep violet blue by contrast with the orange. The wisps of disappearing smoke-clouds, scattered about the sky, also made another beautiful picture. There were many, we feel certain, that could have watched this event for much longer than the 15 mins. allotted to it. Let it be repeated.

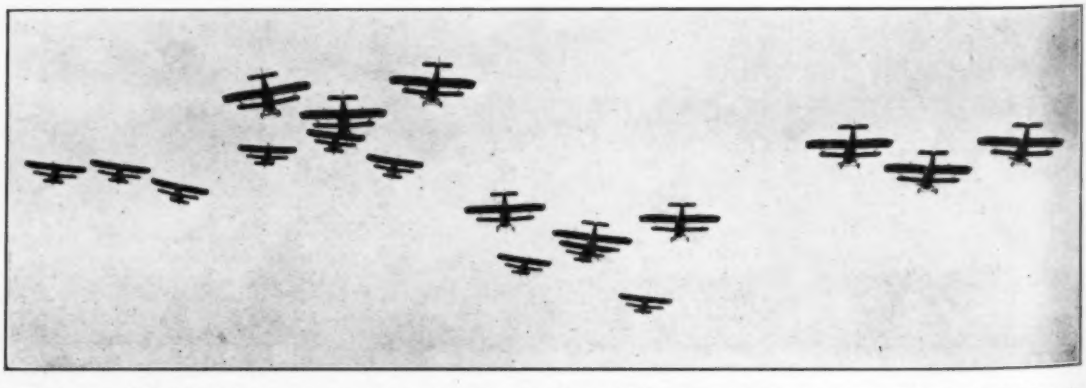
However, apart from the picturesque side of this event, the smoke columns assisted considerably in following the various manœuvres—indeed, the behaviour of the smoke during the different periods of the roll or loop, etc., was most interesting to watch.

Event H. Balloon Chasing.—The final event of the preliminary programme began at 2.25 p.m. This was balloon chasing by two pilots of No. 23 (Fighter) Squadron, Flight-Lieut. F. R. D. Swain and Sergt. J. G. Freeman. The pilot of the first machine to commence the attack, whoever it was, burst his balloons very quickly, often catching one with his machine as he recovered from an attack upon another. Each pilot gave a good show.

The Afternoon Programme

The first event of the main, afternoon, programme was a display of evolutions by three fighter squadrons: No. 1 (Sqdn.-Ldr. E. O. Grenfell, M.C., D.F.C., A.F.C.), No. 25 (Sqdn.-Ldr. L. G. S. Payne, M.C., A.F.C.), and No. 43 (Sqdn.-Ldr. C. N. Lowe, M.C., D.F.C.)—all Armstrong-Whitworth Siskin IIIa's with Armstrong Siddeley Jaguars. These were already in the air when loud cheering heralded the arrival of the Prince of Wales, who drove in his car past the enclosures to the Royal "box"—the National Anthem, played by the R.A.F. Band (under Flight-Lieut. John Amers, M.B.E.), being just audible above the roar of the fighters.

The 27 Siskins, after taking off in formation—a really magnificent sight—flew back and forth across the aerodrome, two squadrons from opposite directions and one from at right angles, all three meeting and crossing one above the other over the centre of the aerodrome. This was accomplished with remarkable precision, and produced an extraordinary effect. They next formed into single file and repeated these evolutions, with, in addition, one or two other wonderful figures. Two squadrons, for instance, proceeded side by side (still in single file), while the third approached from the opposite direction and, on meeting the other two, passed in between them. Then they all formed into one single "snake" and flew round the aerodrome in a large circle, which changed into a spiral. Finally, the "snake" flew past the Royal enclosure, then the leading machine



EVENT I: EVOLUTIONS BY THREE FIGHTER SQUADRONS: Two of the three squadrons of Siskins, in Mass Line Abreast, form a total eclipse. ("FLIGHT" *Photo.*)

executed an Immelmann and doubled back on his track, all the rest following his example in rapid succession.

Event No. 2 was an exhibition of individual acrobatics by the winning pair of pilots in the Fighting Area Aerobatics Competition—Flying Officer C. H. Jones and Flying Officer H. A. Purvis, both of No. 23 Squadron, on Gloster-Jupiter Gamecocks. The evolutions performed were the same as those witnessed at previous displays, but here again there was a "finish" about them that made them different. After taking off together and executing a few simultaneous stunts together—like those American step-dancers one sees on the music-hall stage—they separated and, flying to opposite ends of the aerodrome, turned and dived towards each other; then, meeting and passing, zoomed skywards to execute some evolution—a loop, roll, or the like—in perfect unison. Time and again this was repeated—the two pilots meeting each time, it seemed, exactly over the same spot on the aerodrome, shooting up and "evoluting" at the end of the zoom so that it looked as if one was watching one pilot *and* his reflection in a vast mirror.

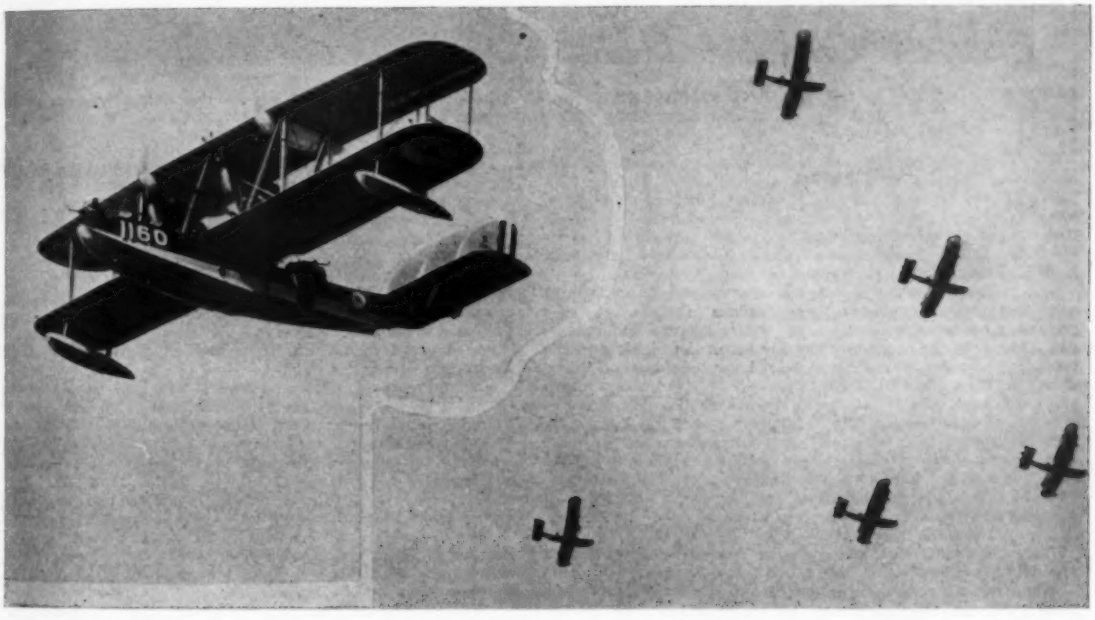
In the meanwhile three Vickers Vimys had ascended in readiness for Event No. 3, which was a simultaneous parachute descent by the Parachute section of the Home Aircraft Depot. When the Vimys took off it was observed that a parachutist stood on a little platform at each wing-tip—in which position they stood all the while the Vimys were cruising round—awaiting their turn in the "wings." As the two Gamecocks made their bow and retired, the Vimys appeared over the aerodrome, then at a given signal the parachutists pulled the "release," and one saw the small pilot parachute set free and blown out behind. This pulled the main parachute out of the pack (on the parachutist's back), which quickly opened in the rush of air and pulled the parachutist off the machine. All six airmen dropped together and started a thrilling race to earth, some swinging, pendulum-like, somewhat violently.

As the parachutes got near the ground, two of them got very close together, until one man swung on to the top of the other. At first things looked rather unpleasant, for although he almost immediately slid off, it was evident that the two parachutes would become entangled. Fortunately, however, the parachutist released another emergency parachute, and both airmen landed safely.

As soon as the six parachutes reached earth, Event 4 started, in the arrival of five Supermarine Southampton flying-boats (each with two Napier Lion engines), which flew over the aerodrome in formation. These boats, which were similar to those which made the Far East Cruise, belonged to No. 201 Squadron (Wing-Commander D. G. Donald, D.F.C., A.F.C.) and had flown over from Calshot—overland practically all the way. They made an imposing sight as they "sailed"—they seemed so slow after the other aircraft that had been taking part so far in the display—across the 'drome, their hulls shining brightly in the sun. At the end of the aerodrome one of the boats dropped out of the formation and turned back, descending low the meanwhile. At first we thought something was wrong, and it was going to "land" in Hendon Seaport, located on the far side of the aerodrome complete with harbour and troopship—it (the seaport) certainly looked real enough from the ground.

However, all was well, and they were only coming down to let us have a close-up view, for it flew back across the aerodrome a few hundred feet up, and then rejoined the others, and all five flew back to Calshot!

Event 5 followed at 3.45 p.m. sharp. This was an attack by No. 41 Fighter Squadron (Sq./Ldr. R. S. Atkin, M.C., A.F.C.), with "Siskins," on an encampment. The squadron had, the programme told us, been ordered to attack a small encampment, and arrived over the latter at about 800 ft., broke up into flights which dived on the camp, using converging tactics and machine-gun fire.



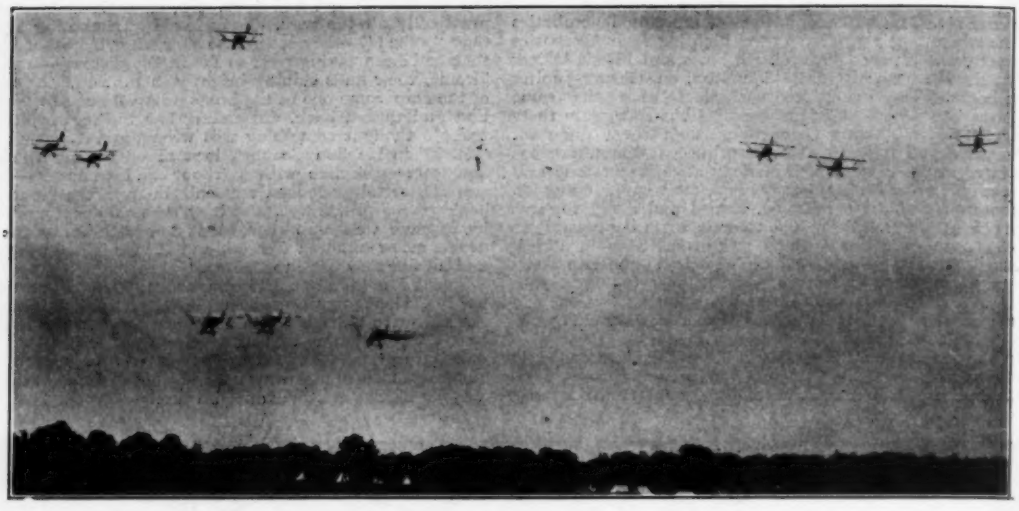
EVENT 4. FLYING-BOATS: Five Supermarine Southampton (Napier Lions) flying-boats of No. 201 Squadron flew over the aerodrome in formation. One dropped out and flew low past the Royal Enclosure, to give us a "close-up" (on the left). ("FLIGHT" *Photo.*)

After this they resorted to low bombing, which, judging by the noise of the explosions and flaming tents, was entirely effective. It was a stirring event to watch, and was also one of much technical interest to students of aerial warfare.

The next event, No. 6, was a demonstration of the various forms of attack by two single-seater fighters against a twin-engined bomber. The actors in this event—which was not only spectacular, but full of high technical interest—were Wing-Commander J. C. P. Wood, of No. 101 Bombing Squadron (Boulton and Paul Sidestrand, two Bristol Jupiter engines), Flying Officer W. J. H. Lindley, of No. 19 Fighter Squadron (Siskin-Jaguar), and Sergt. C. G. Lott, also of No. 19 Squadron.

The two fighters performed all sorts of evolutions round their larger prey with remarkable activity in their endeavour to obtain a position of advantage, loops, rolls, Immelmanns, etc., previously demonstrated "individually," were all brought into play, yet in spite of this the big twin-engined machine appeared to be just as active in getting out of the way.

After a while one of the fighters was put out of action, and realistically brought down "in flames" by a lucky shot from one of the Sidestrand's gunners. But presently, the remaining Siskin got in a favourable position, and the bomber met with a similar fate.



EVENT 5 : ATTACK ON AN ENCAMPMENT : No. 41 Squadron (Siskins) diving on the camp, firing at the same time their machine guns. (" FLIGHT " *Photo.*)

The Army Co-operation Squadron was responsible for the next item, with a demonstration of Message Picking Up. This has been given at previous displays, but this year it was, we think, much more interesting, because flights of three Atlas-Jaguar aircraft, from No. 26 Squadron under Sq./Ldr. R. L. Stevenson, M.B.E., took part, although normally this duty is performed by a single machine.

The message was contained in a bag attached to a loop of cord suspended from two poles driven upright into the ground. Each machine had a rod, with a grapnel hook at one end, hinged to the bottom of the fuselage. In picking up the message the pilot or observer lowered the " fishing rod " and dived between the two ground poles so that the hook caught the cord, and on the rod being drawn up the message bag was pulled into the fuselage. Answers to the messages were put into bags, with long streamers attached, and dropped from the machine.

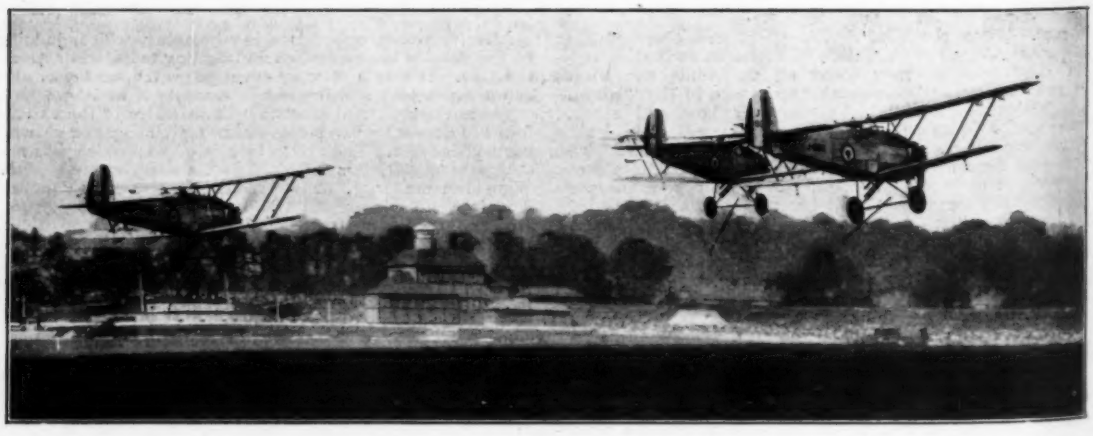
Event 8 was a demonstration of aerobatics in flight formation by three instructors from the Central Flying School, on Genet-Moths. The pilots were Flight.-Lieut. J. S. Chick, M.C., and Flying Officers D. A. Boyle and W. E. P. Johnson. While this event was not, perhaps, quite so spectacular as the demonstration given by the C.F.S. on a previous occasion —when the formation consisted of five machines, and when they performed the famous " double bunt "—it was, nevertheless, a magnificent example of skilful piloting, in which the advance made in Service flying was well brought out.

Flying so close that the red Moths appeared to be tied together, these three flew back and forth across the aerodrome, looping, executing half rolls, slow rolls and spins in truly marvellous fashion. But undoubtedly, the outstanding item of their performance was the inverted flying. They flew in this position in close formation, executing various evolutions as easily as if they were right side up; then one flew upside down with the other two in normal position, alongside, as if they were carrying an injured companion to hospital! Best of all, however, was when, in close inverted formation, they flew the full length of the aerodrome in a series of S's!

Event 9 was an old friend with a new one—a demonstration of high-speed low attacks. Previously, this was given by Fairey Fox day bombers, and was noteworthy in that it was responsible for making spectators who persisted in standing up on their chairs get down from same somewhat hurriedly!

This year, the Fairey Foxes (with Rolls-Royce F.II and Fairey Felix engines), of No. 12 Bomber Squadron, under Sqdn.-Ldr. T. E. Salt, A.F.C., was joined by No. 3 Fighter Squadron, under Sqdn.-Ldr. E. D. Johnson, A.F.C., equipped with the latest addition to the Royal Air Force—the Bristol Bulldog (Jupiter).

" Bombs will not be dropped during this demonstration " said the programme. We were glad of it, too, for the bark of the Fox, as it parted our rising hairs, was sufficiently



EVENT 7. MESSAGE PICKING UP : Three Armstrong-Whitworth Atlas machines of No. 26 (Army Co-operation) Squadron coming in, with hooks down, to pick up their messages. (" FLIGHT " *Photo.*)

unnerving, and only the gentle purr of the Bulldogs chasing the Foxes soothed the aforesaid nerves. The Foxes, by the way, seemed to be much faster this year, while the Bulldogs, in making their public début, put up a good showing.

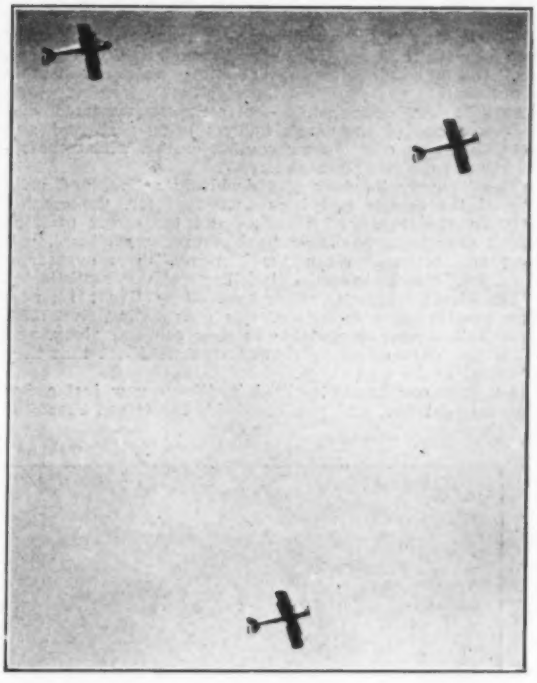
While Event 9 was making day fearful, night was awaiting its turn in the shape of Event 10—a take-off of three Night Bomber Squadrons, which formed up in front of the enclosures and cooled the perspiring spectators with their slip-streams (and some of the aerodrome). The three squadrons taking part (and off) were No. 7, Wing-Comdr. E. R. Manning, D.S.O., M.C. (Vickers Virginias, with Napier Lions); No. 10, Wing-Comdr. A. T. Whitelock (Handley Page Hyderabads with Lions); and No. 99, Wing-Comdr. B. E. Smythes, D.F.C. (also Hyderabads). These squadrons were at half strength, *i.e.*, five machines each.

Their take-off was quite interesting, for, in spite of their great size, they seemed to get into the air very easily and lightly, but once in the air, their size, in contrast with the other machines, gave them the appearance of being very slow.

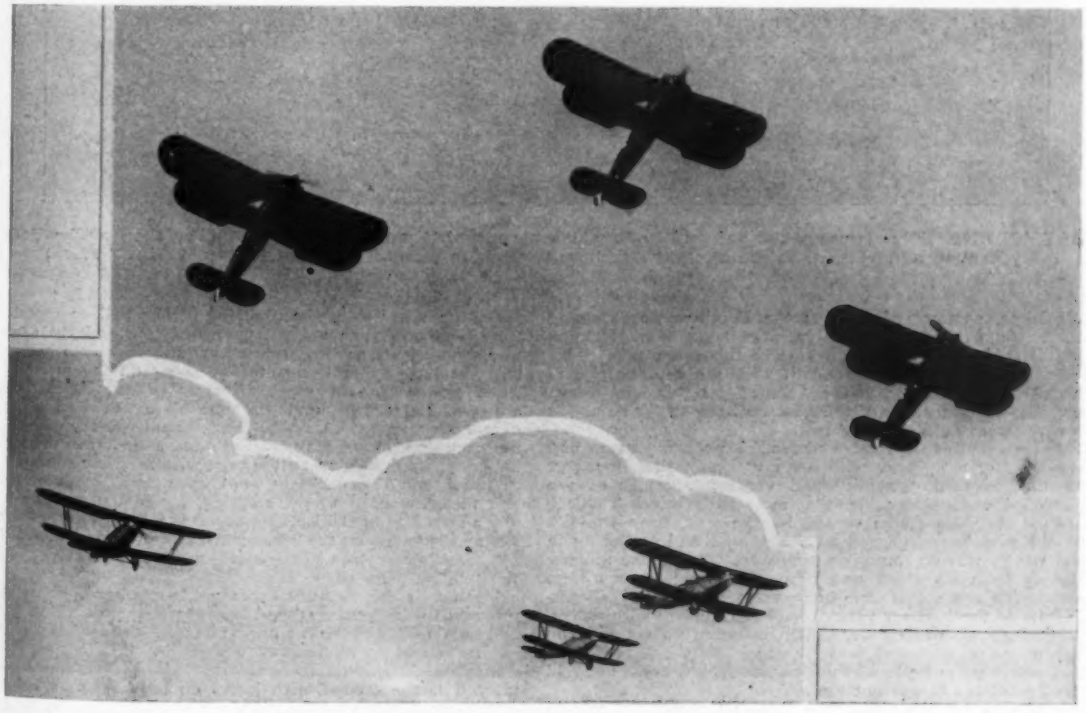
The bombers having departed, we came to Event 11—Individual (very!) Aerobatics, or "Crazy Flying," by two pilots from No. 2 Flying Training School, Flying Officer G. E. Campbell, D.F.M., and Flight-Sergt. Brown, on Avro-Lynx. "Crazy Flying" has always been very difficult to describe in words, although with one doing it—like Noakes, its originator, or poor Longton—it was, to a certain extent, possible. This time, however, with two of them at it, and with infinitely more daring exploits, it is utterly impossible.

When these two were not seemingly stuck together in "unattainable" attitudes, they were at opposite ends of the aerodrome carrying out some contradiction to the laws of gravity and Nature (each one copying the other). Their "Leap-frog" flight across the aerodrome, hopping over imaginary obstacles, was really very amusing. They also flew sideways-side-by-side, a broadside view of which was one of the weirdest things we have ever seen. We shall not forget this event in a hurry.

Event 12 was another air combat of a rather more ambitious character, and with a story attached to it. The actors were Flying Officer J. G. Elton, of No. 101 Bomber Squadron (Sidestrand); Flying Officer C. H. A. Colman; Pilot Officer J. A. Greenshields; Flight-Lieut. J. N. Boothman;



EVENT 8. FLIGHT AEROBATICS: Three Genet-Moths of the Central Flying School, piloted by Flt.-Lieut. J. S. Chick, M.C., and F./O's. D. A. Boyle and W. E. P. Johnson, flying in formation across the aerodrome upside down. ("FLIGHT" *Photo.*)



EVENT 9. LOW ATTACKS: A demonstration of low attacks was given by Day Bomber and Fighter Squadrons. Above are seen three Bristol Bulldogs of No. 3 Fighter Squadron and, below, three Fairey Foxes of No. 12 Bomber Squadron.

and Flying Officer H. W. Charnock, all of No. 32 Fighter Squadron (Siskins).

The "Story" was as follows:—A twin-engined bomber had been sent on a special mission to bomb a selected target. As it was proceeding over enemy territory where considerable air opposition was expected, three fighters were detailed to escort it. An enemy single-seater fighter appeared and attacked, one of the escort fighters being destroyed and another drawn off. An air combat ensued whilst the remainder of the raid proceeded.

The "enemy" fighter was decidedly active, and after one of the escorts had been accounted for, the combat between the "enemy" machine and the escort machine which thought it advisable to take matters in hand, was long and furious. When the "enemy." was eventually "bagged," it came to earth, à la falling leaf, very realistically.

The Night Bombers, which took off in Event 10, now flew past in open formation, this constituting Event 13. They looked very formidable as they rumbled along, and with their dark colouring showed without doubt that they belonged to the night.

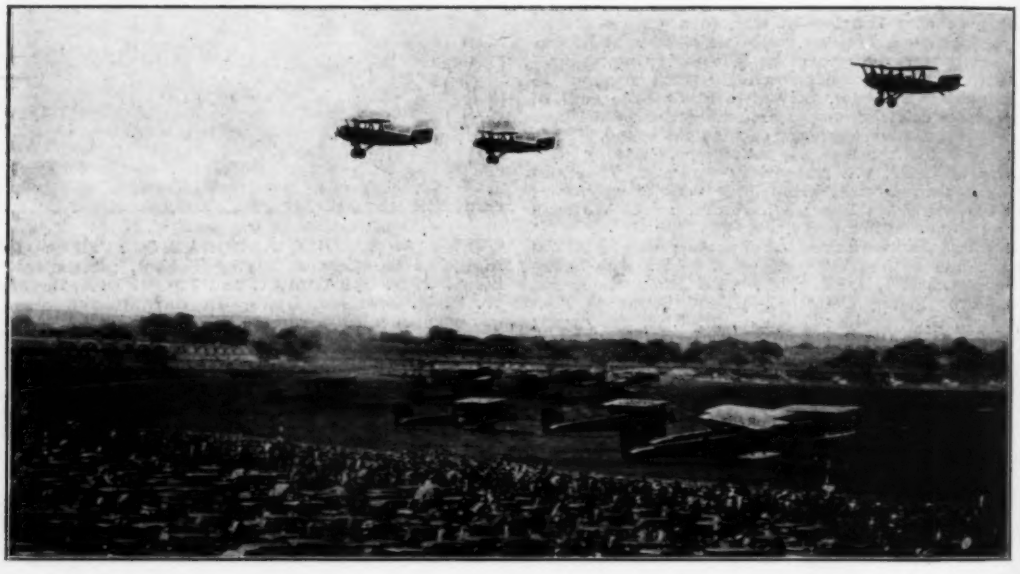
Although one hardly realised it, it was now just a few minutes past five, and the Event 14, the Grand Finale or

the foreign Power committed a definite act of aggression against this country, and intelligence reached the British Government that following up this act, the foreign Power was despatching an expedition from the port against British territory.

As a result, the Government despatched a force of heavy bombers, together with an aircraft carrier, to British territory within range of the port to resist the despatch of the expedition. This was the state of affairs when the scene opened with the arrival overhead of an Army Co-operation Atlas, which carried out close reconnaissance and took photographs of the situation—the enemy anti-aircraft guns opening fire the meanwhile.

The pilot sent a report by wireless to the aircraft carrier, and the following message came through clearly *via* the loud speakers opposite the enclosures:—

"I am now over the port. I have taken several photographs as instructed. Transport with two yellow and black funnels alongside the quay. Troops are embarking, and stores are being loaded into it. There are several lorries on the quay. Most of the troops are aboard. I have been heavily bombarded by enemy fire. The enemy has sent up an observation balloon."



DAY AND NIGHT: Three of the Fairey Fox Day Bombers, taking part in Event 9, fly over the Handley Page Hyderabad and Vickers Virginia Night Bombers waiting to take off in Event 10. ("FLIGHT" *Photo.*)

Set Piece, commenced. When the Bombers were passing over, we noticed considerable activity around Hendon Sea Port, located on the far side of the aerodrome. This port, constructed by the R.A.F. with scrap material and wonderful ingenuity, was the "stage" for this final event, and was certainly one of the best we have so far seen. It was realism to a high degree.

It represented a foreign defended port overseas, and consisted of a harbour with a quay terminating in a fort at the seaward extremity and various buildings at the landward end. Alongside the mole with waves rippling against its sides (these waves, by the way, were the silk of old parachutes, pegged to the ground and fluttering in the wind), was an imposing troopship, with smoke already issuing from its black and orange funnels; troops were embarking and stores were being transferred from lorries.

Outside the harbour various vessels, complete with waves, cruised about, while other craft, including an ammunition lighter, were anchored inside. This was the "peaceful" but active scene we looked upon at the start, and one could hardly believe it was not real.

And now for the plot. The British Government was in diplomatic correspondence with this foreign power in relation to the disputed boundary of a British overseas possession, and had referred the question to the League of Nations. Without waiting for the report of the League of Nations,

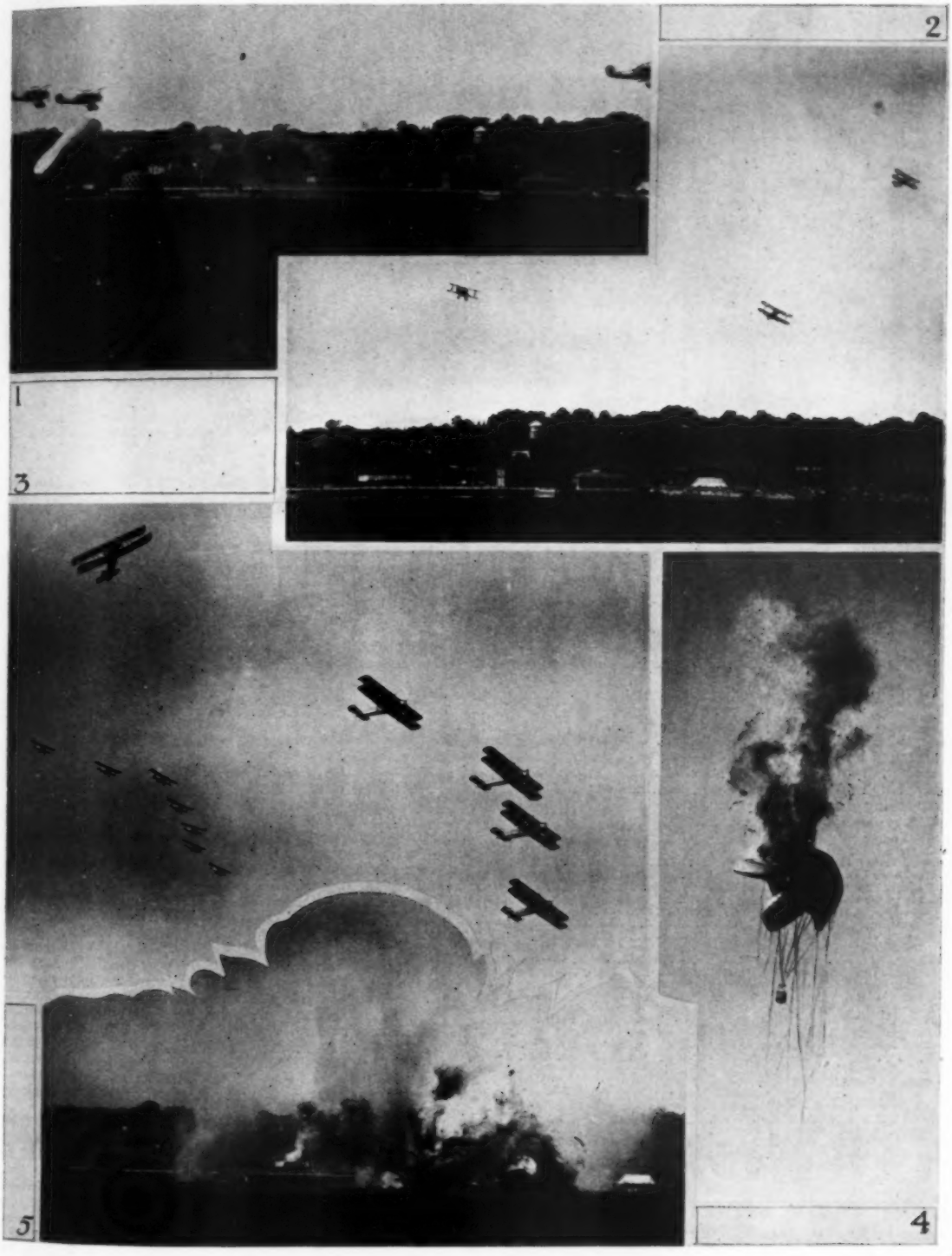
On the other side, the observer in the balloon reported that further British aircraft were arriving, and the alarm was sounded—the various craft hurrying back into harbour and the lorries and troops taking cover on the mainland. Then a squadron of Fleet Fighters (Fairey Flycatchers) appeared, attacked, and brought down in flames the observation balloon (Air Vice-Sergt. Sandbags, the observer, unfortunately forgot his parachute and came down with the balloon); they also raked the port with machine-gun fire.

A squadron of enemy fighters ("Siskinskys") next arrived, and matters began to get exciting, for in the distance we saw a squadron of British bombers approaching in formation. Before they got over the harbour the enemy fighters attacked, resulting in losses on both sides—but the bombers got in a few "pills" with good effect.

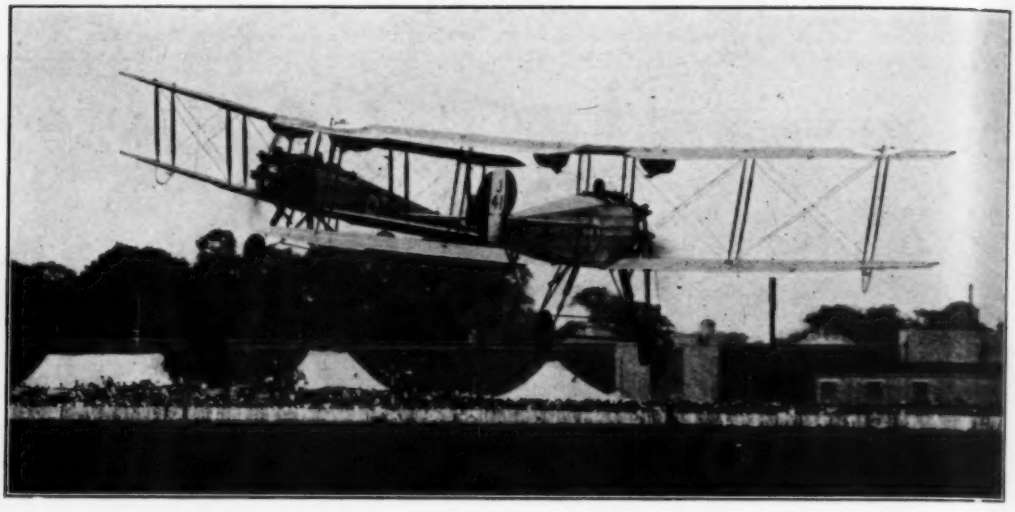
Meanwhile, the Atlas was still overhead, reporting progress to headquarters, and his reports came through now and again above the roar of aircraft, guns and bombs. Another enemy squadron of "Siskinskys" arrived, together with more British bombers escorted by fighters, and a real pitched battle ensued, with losses on both sides as before and more damage to the port.

The British fighters eventually drove off the others, and the air being more or less free, a squadron of Fairey III F bombers came along and neatly tidied up the port, including transport, mole, and buildings, and then gracefully retired.

TENTH R.A.F. DISPLAY



EVENT 14: AIR BATTLE AND SET PIECE: (1) The Port of Hendon-by-the-Sea before the outbreak of hostilities (the machines are those taking part in a previous event). (2) "Flycatchers" of the Fleet Fighter Squadron (No. 405) open the attack with machine guns, having (4) brought down in flames the enemy kite balloon. (3) British Heavy Bombers arrive, followed by attacking enemy fighters ("Siskinskys"). (5) With the help of Fairey III.F bombers (No. 207), Hendon Sea-port becomes an "Air-port." ("FLIGHT" *Photos.*)



EVENT 11. " CRAZY FLYING " : Two Avro-Lynx of No. 2 Flying Training School, piloted by F./O. G. E. Campbell and Flt./Sergt. Brown mix themselves up so much, that we regret we cannot say which is which!
(" FLIGHT " *Photo.*)

But the fun was not yet over. A scouting vessel of the enemy fleet appeared, making for the harbour, which, no longer existed, so it thought better of it and retired, laying a smoke screen as it did so (and there was plenty of smoke about by now).

The Squadrons and Commanding Officers which took part in this event (producing 43 machines in all) were as follows :—

No. 13 Army Co-operation, Flying Offr. P. N. R. Hallward, (Atlas-Jaguar). No. 29 Fighter, Sqdn.-Ldr. M. L. Taylor, A.F.C., (Siskin-Jaguar). No. 56 Fighter, Sqdn.-Ldr. A. Lees, (Siskin-Jaguar). No. 207 Bomber, Sqdn.-Ldr. E. A. Beaulah, (Fairey IIIF Lion). No. 405 Flight Fleet Fighter, Flt.-Lt. M. V. Ward, (Flycatcher-Jaguar). No. 10 Night Bomber, Wing-Commander A. T. Whitelock, (Hyderabad-Lion). No. 99 Night Bomber, Wing-Commander B. E. Smythies, D.F.C., (Hyderabad-Lion). School of Balloon Training, Flt.-Lt. C. W. Harrison, Captive Kite Balloon).

Thus ended one of the best " staged " and well-told air " Set Pieces " we have seen, a fitting conclusion to the Tenth Royal Air Force Display, which was " better than ever."

Next year's Display, the Eleventh, will—well, well, well! *Goodness only knows* !

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R.A.F. Dinner Club

THE Prince of Wales and the Rt. Hon. Sir Samuel Hoare attended the seventh annual dinner of the Royal Air Force Dinner Club on July 12. Marshal of the Royal Air Force Sir Hugh Trenchard presided, and among the members attending were the following :—

Air Chief Marshal Sir John Salmond ; Air Marshals Sir John Higgins and Sir Geoffrey Salmond ; Air Vice-Marshals C. L. Lamb, C. Longcroft, Sir Oliver Swann, Sir Philip Game, and Sir Vyell Vyvyan ; Air Commodores Bowhill, the Hon. T. D. Boyle, Drew, Holt, Longmore, Ludlow-Hewitt, MacEwen, Newall, Warrington-Morris, Fellowes, and the Rev. R. E. Vernon Hanson ; Capt. Birkett, R.N. ; Colonels T. E. St. C. Daniell, Sir Walter Lawrence, and Finch Noyes ; Group Captains Barratt, Bettington, Busted, Bigsworth, Christie, Courtney, Foster, Gossage, Gill, Rathborne, Ross, Smyth-Pigott, Cave-Brownu-Cave, and Grenfell ; Lieut.-Coles Donaldson-Hudson, Fell, Sir Francis McClean, Rabagliati, and Dore.

Wing Commanders S. T. Babington, Hetherington, the Hon. Maurice Baring, Bailey, Barton, Colbran, Cordingley, Don, Douglas, Evill, Garrod, Gould, Graham, Grant-Dalton, Laws, Macdonald, Maude, Maund, Maycock, Murlis-Green, Murray, Nicholl, Parry, Peck, Robinson, Ryan, J. Sowrey, Sutton, Tyssen, Ward, Welsh, Hicks, Sedder, F. Sowrey, and Collishaw ; Majors Beatson, Bulman, Fiske, Lambert, Moller, Pye-Smith, Reynolds, Somers-Clarke, and Windeler ; Sqdn.-Ldrs. J. O. Andrews, Baker, Beauman, Black, Budgeon, Burge, Capel, Cockey, Cole-Hamilton, Coningham, de Roeper, Don, Ellerton, R. Graham, Elmhirst, England, Evans, Everidge, Gilley, F. E. Guest, Hall, Hamilton, Hollinghurst, Jones-Williams, Lees, Leslie, McEntegart, Maynard, Rea, Ridley, Russell, Slessor, Thomas, Wann, Workman, Williams, Glenny, Orlebar, and Scott.

Capts. Bailey, Dainty, Furniss, Herbert, Hogarth, Moore, Ramsay, Sayers, Waddington, Woodford, Findlay, and Plugge ; Flt.-Lieuts. Andrews, Allen, Cahill, Chick, Dearlove, G. E. Gibbs, V. R. Gibbs, Gillman, Halford, Hilton, Martin, Sorley, Whitaker, Durrant, Jenkins, Openshaw, Wiggin, Wilson, Eales-White, May, Pope, Mellon, and the Rev. C. S. Ensell and the Rev. C. F. Neate ; Messrs. Atcherley, Broadway, Colebrook, Crosbee, E. B. Fielden, N. Fielden, Gowing, Howes, Hurst, Jones, Newsome, Pumphrey, Purdey, Snowden-Gamble, Stubbs, Walker, Winter, Barfoot-Saunt, Grey, Trush, Yeatman, Presland, Switzer, and Ward.

Our Full-Page Pictures This Week

When the " Fly-past " was deleted from the Royal Air Force Display at Hendon this year, the theory was that all the latest types of service aircraft would be shown at Olympia, and that there was thus no need to put them in a procession at Hendon. As it happened, several new service types are not at Olympia, nor did they appear in any revolution at the Display last Saturday. We have therefore thought that our readers would be interested in seeing photographs of these latest types of British service aircraft, and we are publishing full-page photographs of 10 of them on pp. 685-694 of this issue of FLIGHT.

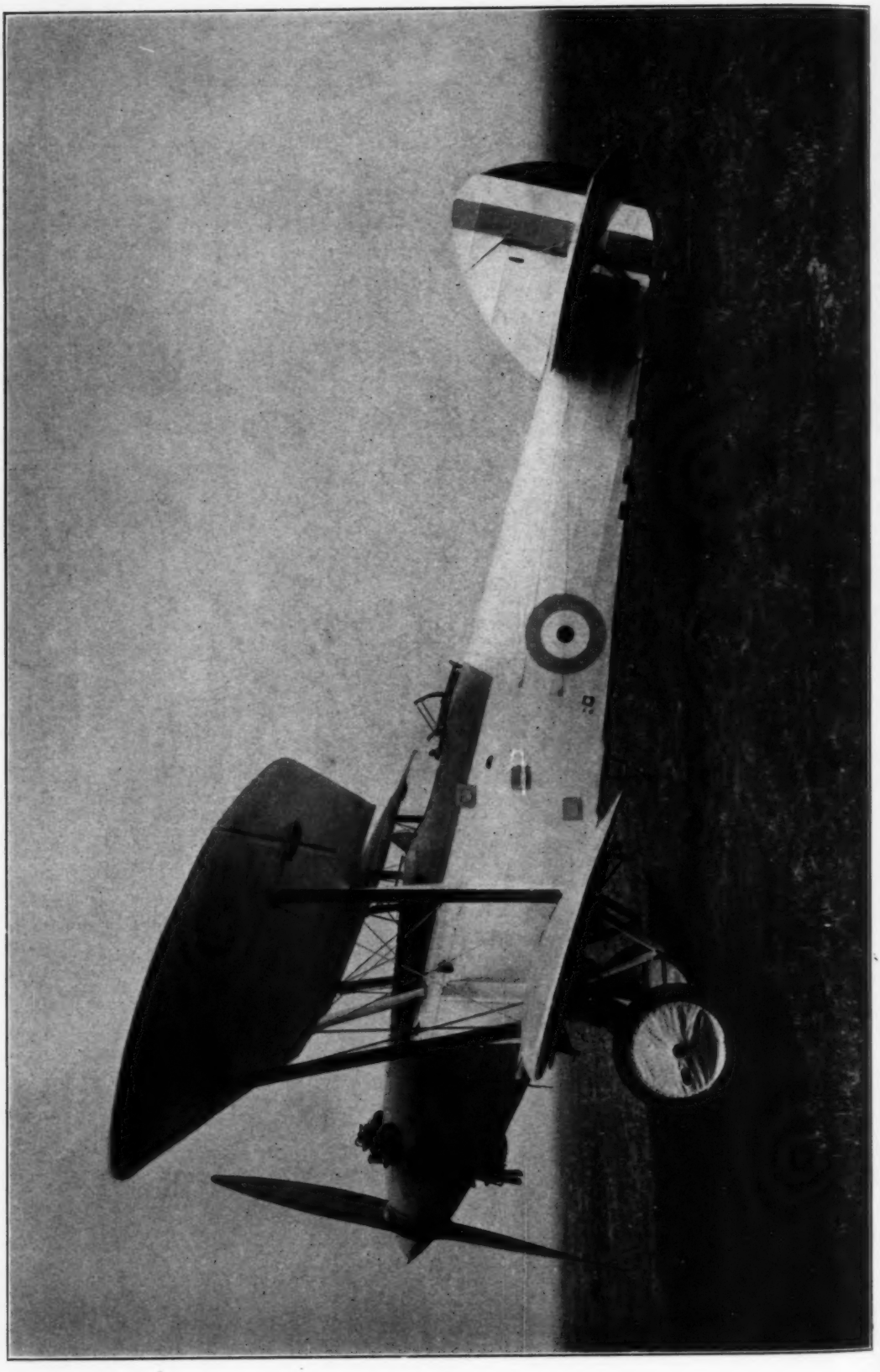
R.Ae.Soc. Conversazione

ON Thursday, July 25, the Royal Aeronautical Society with which is incorporated the Institution of Aeronautical Engineers, will hold a Conversazione in the Science Museum, South Kensington, by kind permission of the Director, Colonel Sir Henry Lyons, F.R.S. The date chosen is the Twentieth Anniversary of the first aeroplane flight across the English Channel, and, by courtesy of the French Authorities, the original machine in which M. Blériot made his historic flight will be on exhibition at the Science Museum for the evening. During the evening the Wilbur Wright Memorial Lecture will be delivered by the Hon. William P. MacCracken, jnr., Assistant Secretary of Commerce for Aeronautics, and member of the National Advisory Committee for Aeronautics of the United States of America. The lecture is entitled " Science in its Relation to Regulating and Promoting Civil Aviation." The approximate programme for the evening will be :—8.30—9 p.m. Reception by the President, The Master of Sempill, and Council. 9.15-10 p.m. Delivery of the Wilbur Wright Memorial Lecture by the Hon. William P. MacCracken, jnr. 10-midnight. Conversazione.

By kind permission of the Air Council, the band of H.M. Royal Air Force, conducted by Flight-Lieut. J. H. Amers, M.B.E., Director of Music, R.A.F., will play from 8.30 to 9 p.m. and from 10 p.m. till 11.45 p.m.

A distinguished company, including most of the foreign notabilities who are attending the Aero Exhibition, will be present, and it is hoped that there will be a large attendance of members and their guests. Applications may be received from non-members. Ladies are specially invited to be present. Evening dress with orders and decorations will be worn. Tickets are 5*s.* each, which include the buffet, but no tickets will be forwarded unless a remittance is enclosed, and applications for tickets must be received by Monday, July 22.

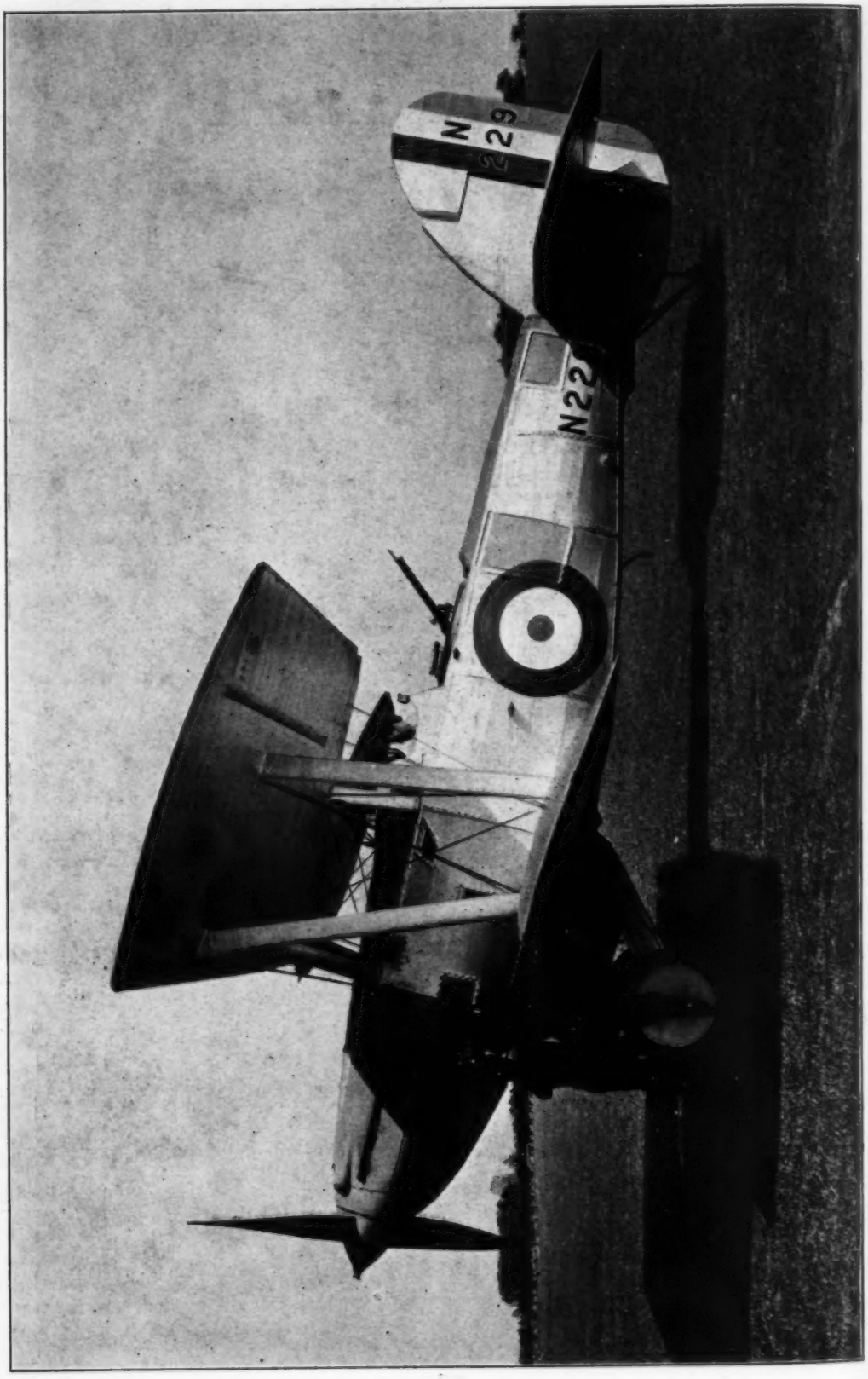
THE BLACKBURN "BEAGLE": Fitted with a Bristol "Jupiter" Engine this machine can be used either as a Torpedoplane or as a Bomber.



THE HAWKER HARRIER: A Single engined Bomber, fitted with Bristol-geared Jupiter engine. (*R.A.F. Official Photograph.*)

THE HAWKER HARRIER: A Single-engined Bomber, fitted with Bristol-geared Jupiter Engine. (R.A.F. Official Photograph.)

THE HAWKER HOOPOE is an experimental deck-landing Fleet Fighter, fitted with Bristol Mercury Engine. ("FLIGHT" *Photo.*)



THE SHORT GURNARD I is a deck-landing, two-seater Fleet Fighter Reconnaissance Machine with Rolls-Royce "F" Type Engine. Interchangeable land and float undercarriages are provided.

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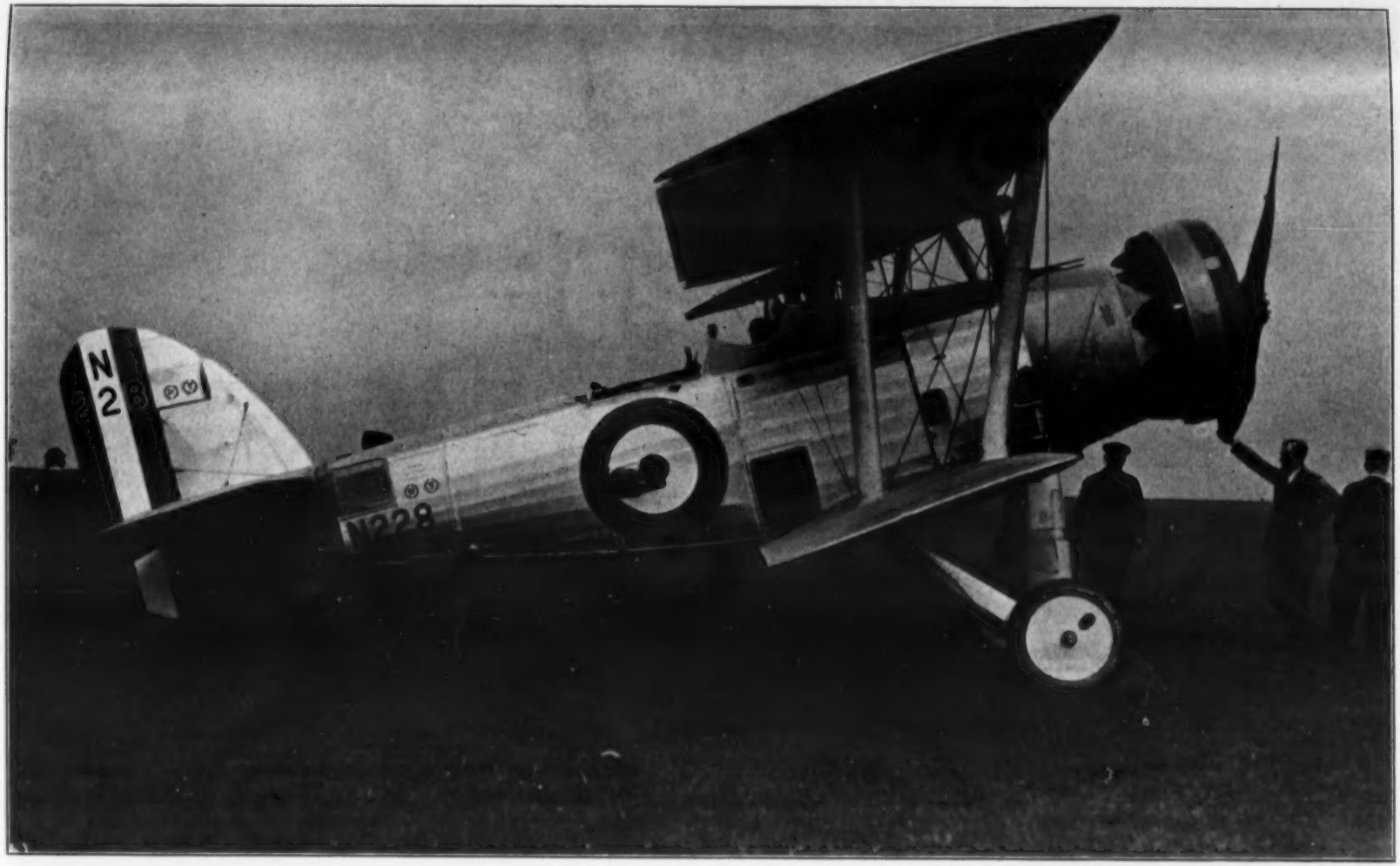
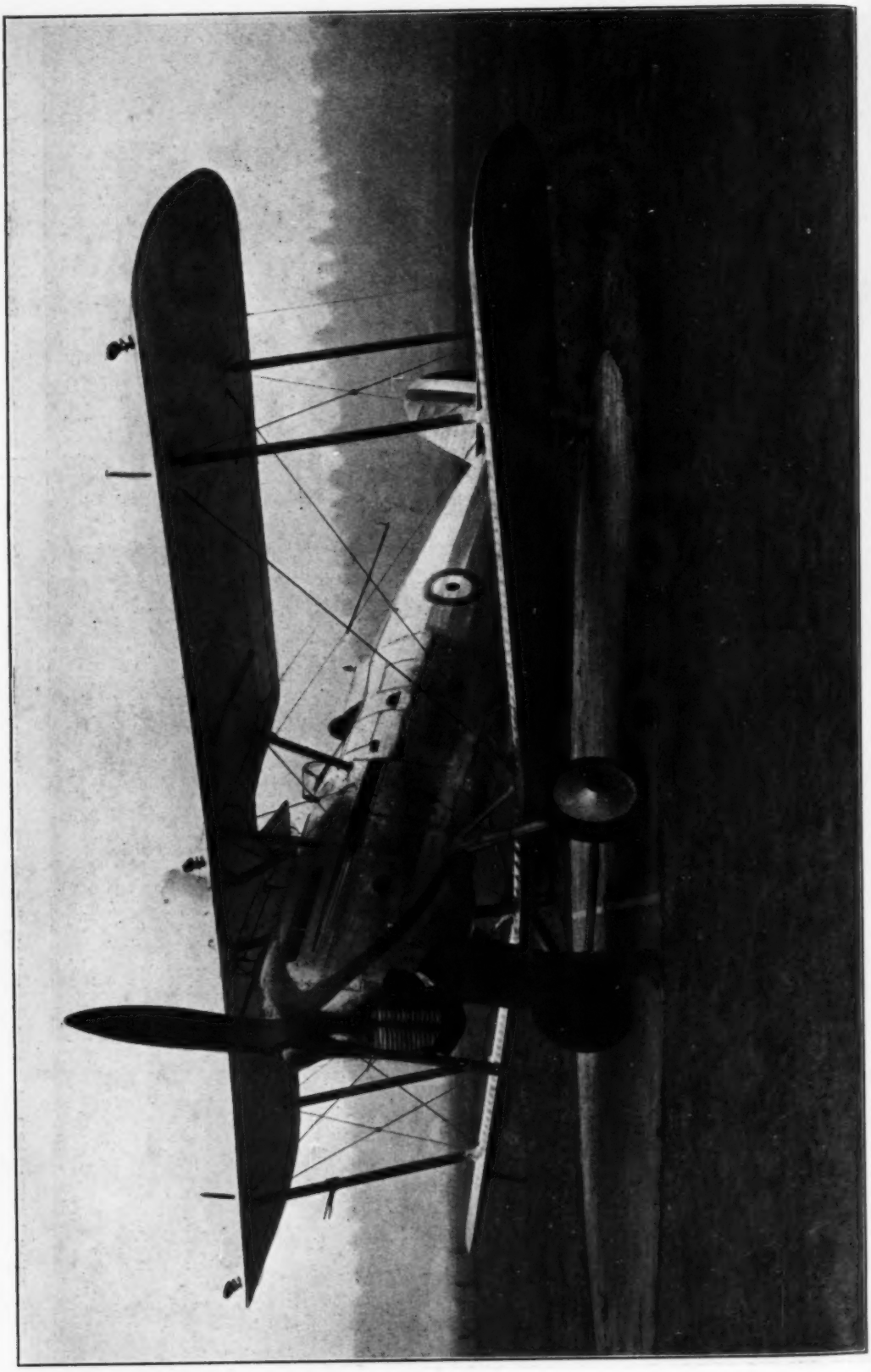


THE SHORT GURNARD II: A Deck-landing, Two-seater Fleet Fighter Reconnaissance Machine with Bristol Jupiter Engine. Note Townend Ring.



THE VICKERS TYPE 141 : This is a Single-seater Ship's Fighter, fitted with Rolls-Royce F.XI Supercharged Engine.

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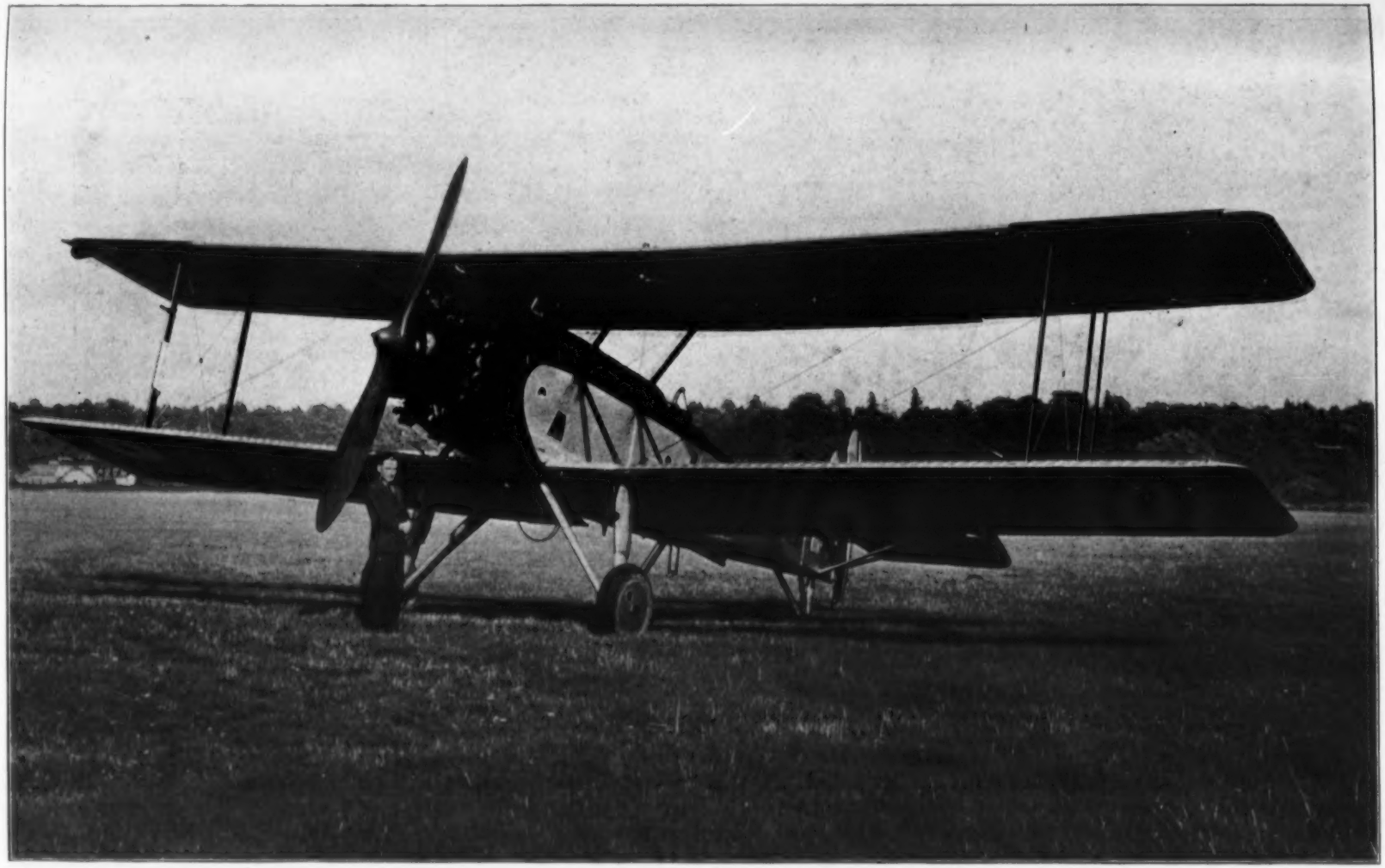
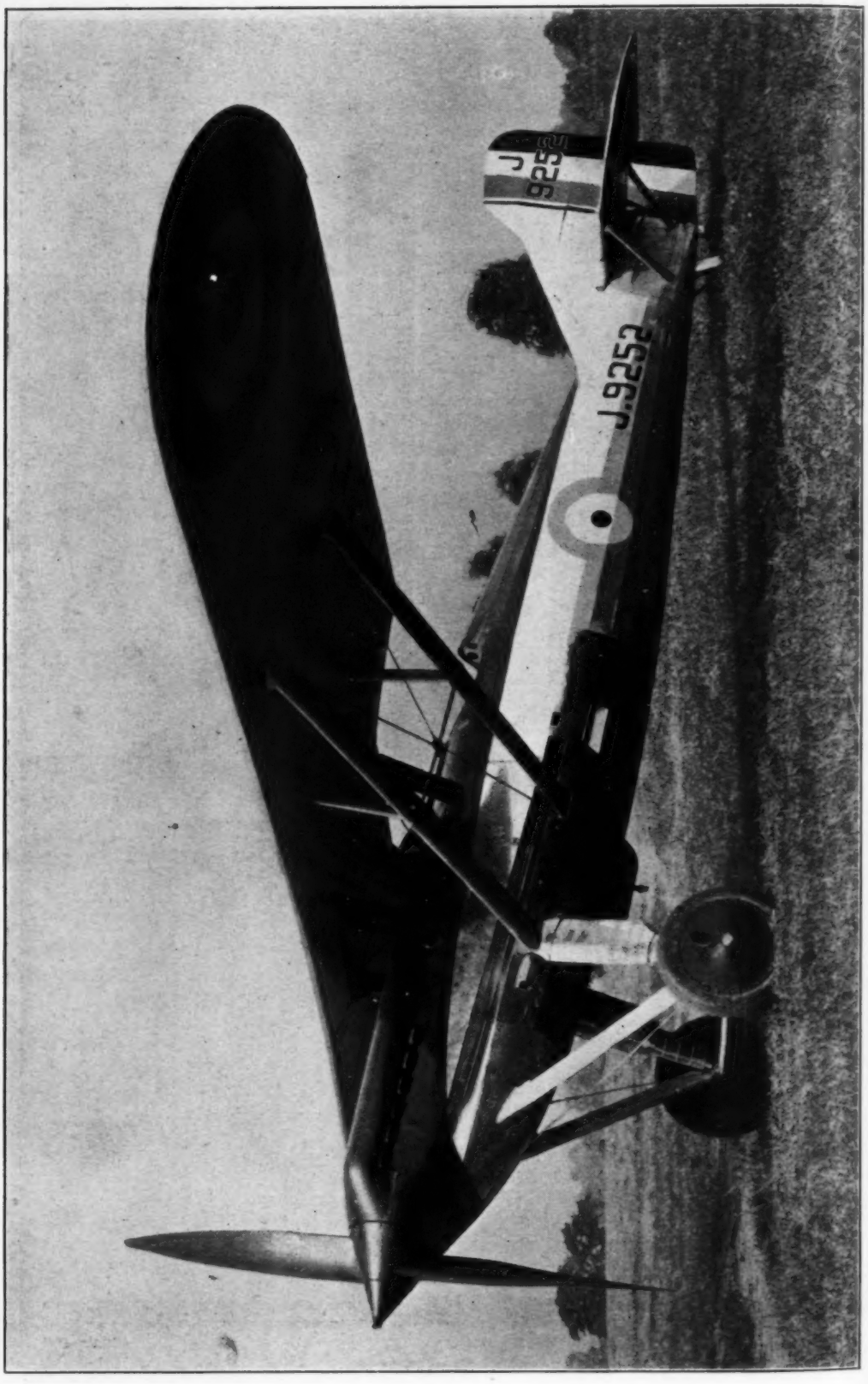


THE VICKERS VILDEBEEST : A two-seater Torpedoplane with Bristol Jupiter VIII Engine.



THE WESTLAND WIZARD II : A Single-seater Fighter of recent production, fitted with Rolls-Royce "F" Type Engine.

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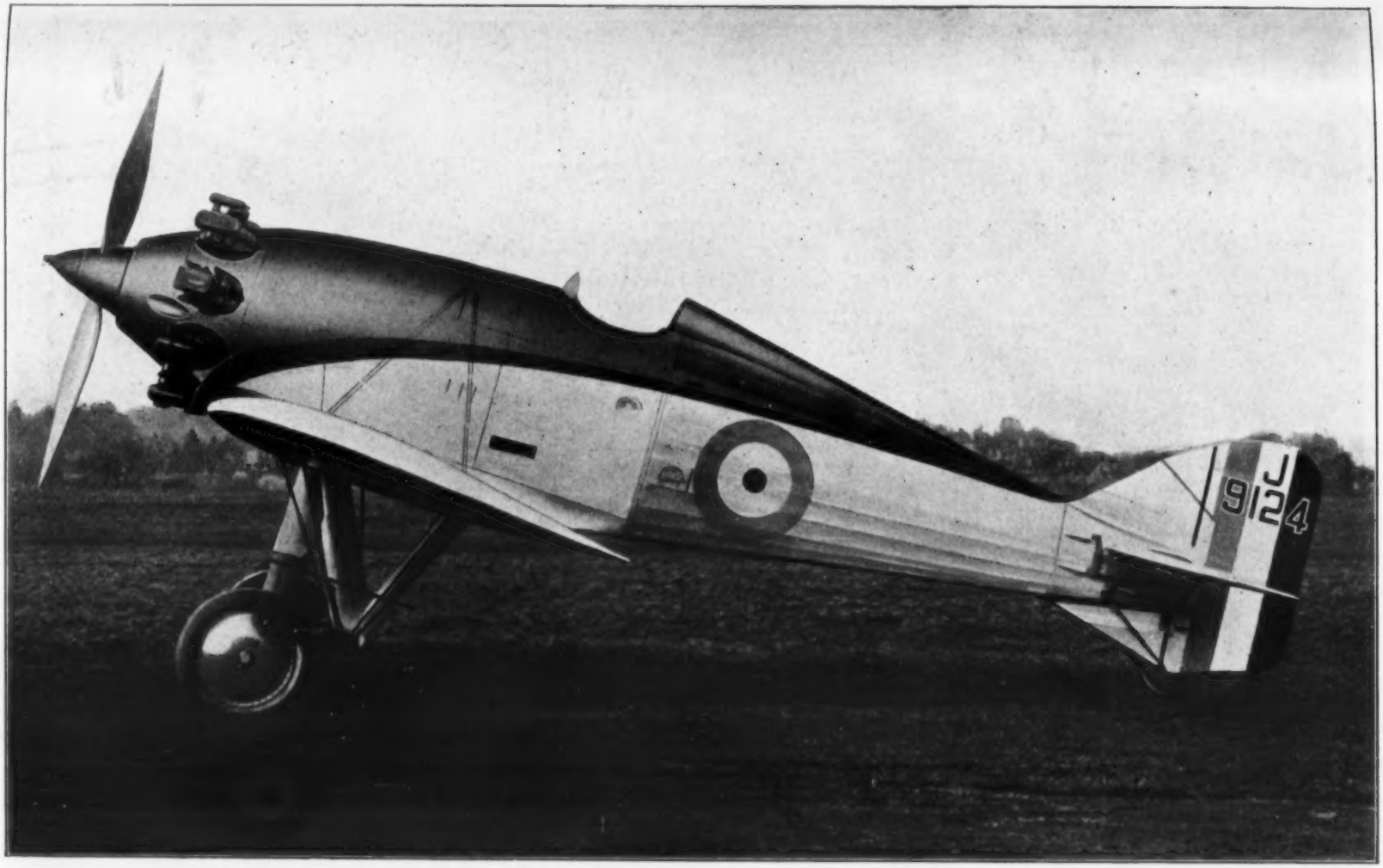
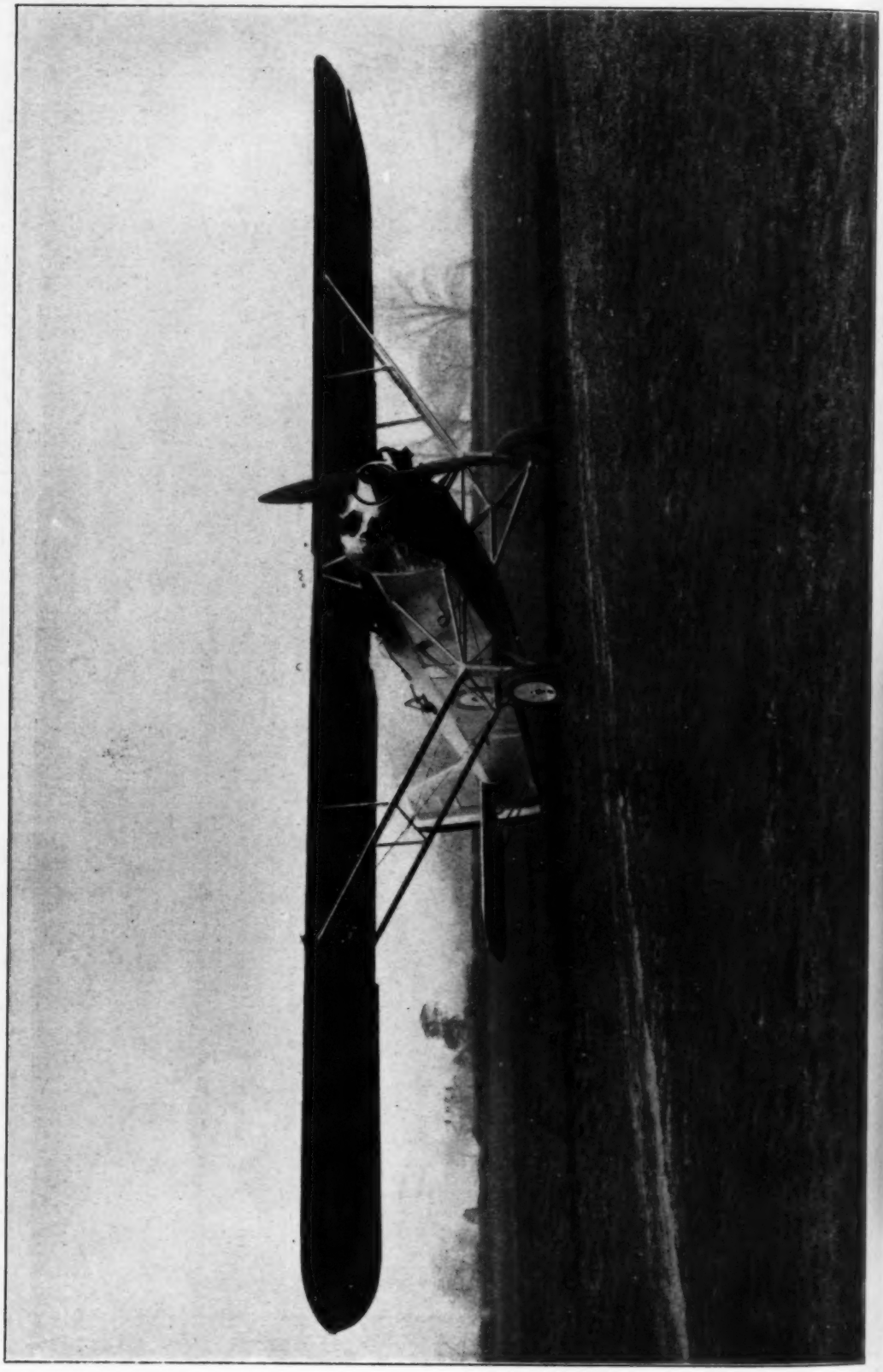


THE WESTLAND INTERCEPTION FIGHTER : This is a Single-seater designed to operate at great altitudes. The engine is a Bristol Mercury.



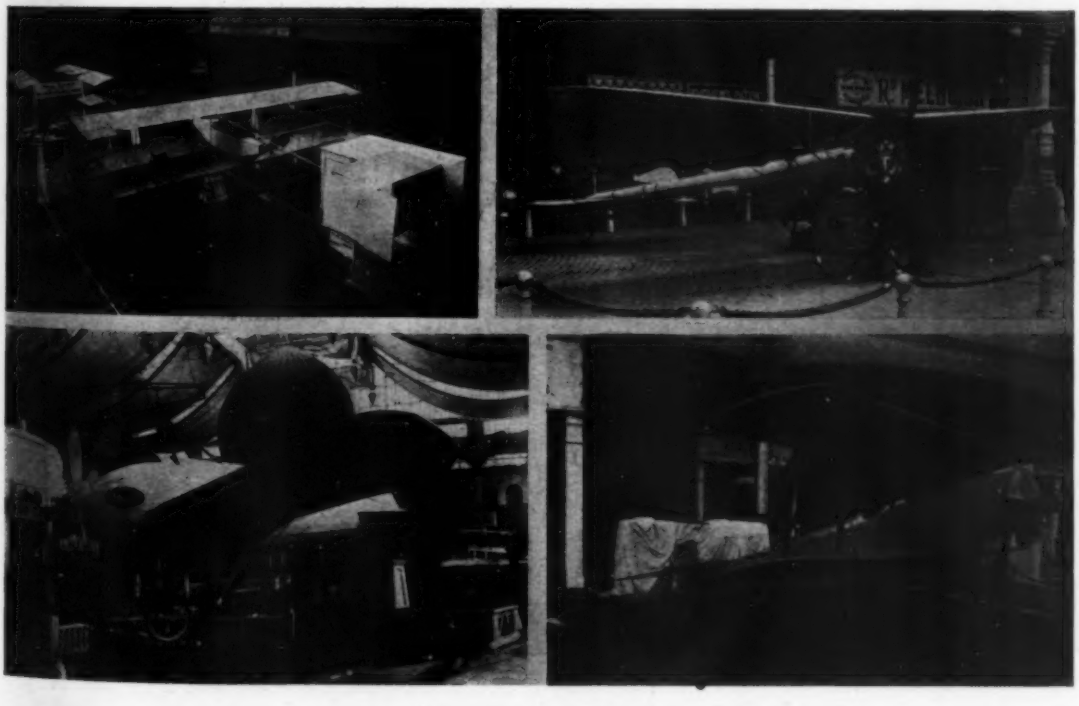
THE WESTLAND WITCH : This is a Day-bomber fitted with Bristol Jupiter VIII Engine.

OLYMPIA

"FAR and away the best Aero Show ever held in Europe." Thus was one visitor heard to describe the International Aero Exhibition, which was declared open by His Royal Highness the Prince of Wales on Tuesday of this week. And without being prejudiced we believe that this claim can be justified. We are basing this view not merely on the monetary value of the collection of aviation material gathered within the walls of Olympia, although that is probably in the neighbourhood of 1½ million sterling, but on the general technical excellence of the machines, engines and accessories exhibited. Out of a total of something like 70 aircraft, there is not one in Olympia which cannot be taken seriously; not one which has not flown or is at least undoubtedly capable of flying, and flying well.

As regards British aircraft, the Show bears evidence of the broad view which the Air Council has taken. On stand after stand one comes across service type which, until quite recently, were on the "Secret List" of the Air Ministry. Yet they have been permitted to be exhibited. Not, it is true, with entire freedom in the matter of information which may be given away concerning them. That would be expecting rather too much. But at least the many interested visitors from abroad are able to see at Olympia the general appearance, and to appreciate the excellent lines and aerodynamic design of some of our very latest types. If the firms concerned are not at the moment permitted to furnish full performance figures, or to sell to foreign powers some of these machines, they can at least show the machines to any potential purchasers that may come along, and when it does become possible to sell, the foreign representatives will have seen, and obtained a very good idea of, these very recent types. That cannot fail to be of value to the British aircraft industry.

The range of British aero engines, from those of but 30 h.p. or so up to power units of not far short of 1,000 b.h.p., will without a doubt arouse the keenest appreciation among foreign visitors. Certain engines are shown sectioned, and thus exhibit the superb workmanship which normally is apt to lie hidden in the interior. In others the external finish is as perfect as is the internal, and may be appreciated from a mere inspection of the engines on the stands. If there is but little in the way of novelties, there is, on the other hand, scarcely an engine at Olympia which has not proved its worth; many types have even established world-wide reputations. And the Show is certainly not devoid of novelties. To mention but two among the British aero engines, there is the Redrup "axial" engine, which strikes an entirely new note and is neither "wobble-gear" nor "swashplate" engine. Then we have the Sunbeam compression ignition engine, in which the Diesel principle is applied to an engine intended for



SHADES OF OLYMPUS! Four examples of early aircraft exhibited at previous Olympia Aero Shows. Above, on the left, is the biplane exhibited in 1909 by Howard T. Wright. The entire framework was of steel and it had tandem airscrews driven by a 50 h.p. Metallurgique engine. On the right, the Humber monoplane, designed by Le Blon and shown in 1910, in which the pilot sat astride the fuselage. Below on the left, is the Piggott all-enclosed monoplane of 1911—a forerunner of the present-day cabin machine? On the right, the Bristol Scout (80-h.p. Gnome) of 1914, perhaps the first of the modern, high-speed Military machines. It played an important part in the Great War which opened that same year.
("FLIGHT" *Photos.*)

THE WESTLAND WITCH! This is a Day-bomber fitted with Bristol Jupiter VIII Engine.

aircraft work. It is to be regretted that the Beardmore engines which have been produced for R.101 are not exhibited, but doubtless there were good reasons for their absence.

On the civil side Olympia can indeed claim to have "something for every taste," and he would be a difficult customer to please who could not find something to suit his requirements. From the "motor cycle of the air," as represented by the A.B.C. Robin, the Boulton and Paul Phœnix and the Glenny and Henderson Gadfly, to the four-engined Handley Page 40-passenger machine at the other end of the scale there is a vast number of intermediate types. In the seaplane class the types exhibited range from small two-seaters, some float seaplanes and some flying-boats, to the giant hull of the Blackburn Nile. Light 'planes with interchangeable land and float undercarriages abound, some "open" and some of the *conduite interieure* type. At least one amphibian light 'plane, a Gipsy Moth with a novel type of amphibian undercarriage by Short Brothers, may be inspected in detail, and gives promise of being a really useful and serviceable machine, still capable of carrying pilot and passenger in spite of the extra weight of the amphibian undercarriage.

Perhaps the great feature, in the private flying class of machine, of this year's Olympia Show may be said to be that, in addition to the light 'plane two-seater as we have become accustomed to it, the private owner now has considerable choice both "up" and "down" the scale. Upwards he has such machines as the Parnall Elf and the Saunders "Cutty Sark, and downwards he has the small cheap single-seaters.

The "feeder line" type of aircraft, hitherto somewhat neglected by British constructors, has now materialised both in the single-engined and in the multi-engined version. Of the former one may mention the de Havilland Hawk Moth and the new Bristol 110A, while in the latter there is the new Avro 5, with three Genet Major engines.

THE LARGEST COMMERCIAL FLYING-BOAT: The hull of the Blackburn Nile. ("FLIGHT" *Photo.*)

Altogether Olympia is extremely well worth visiting, and no reader of FLIGHT who can by hook or by crook manage to do so should miss a visit. He (or she) will not regret it.

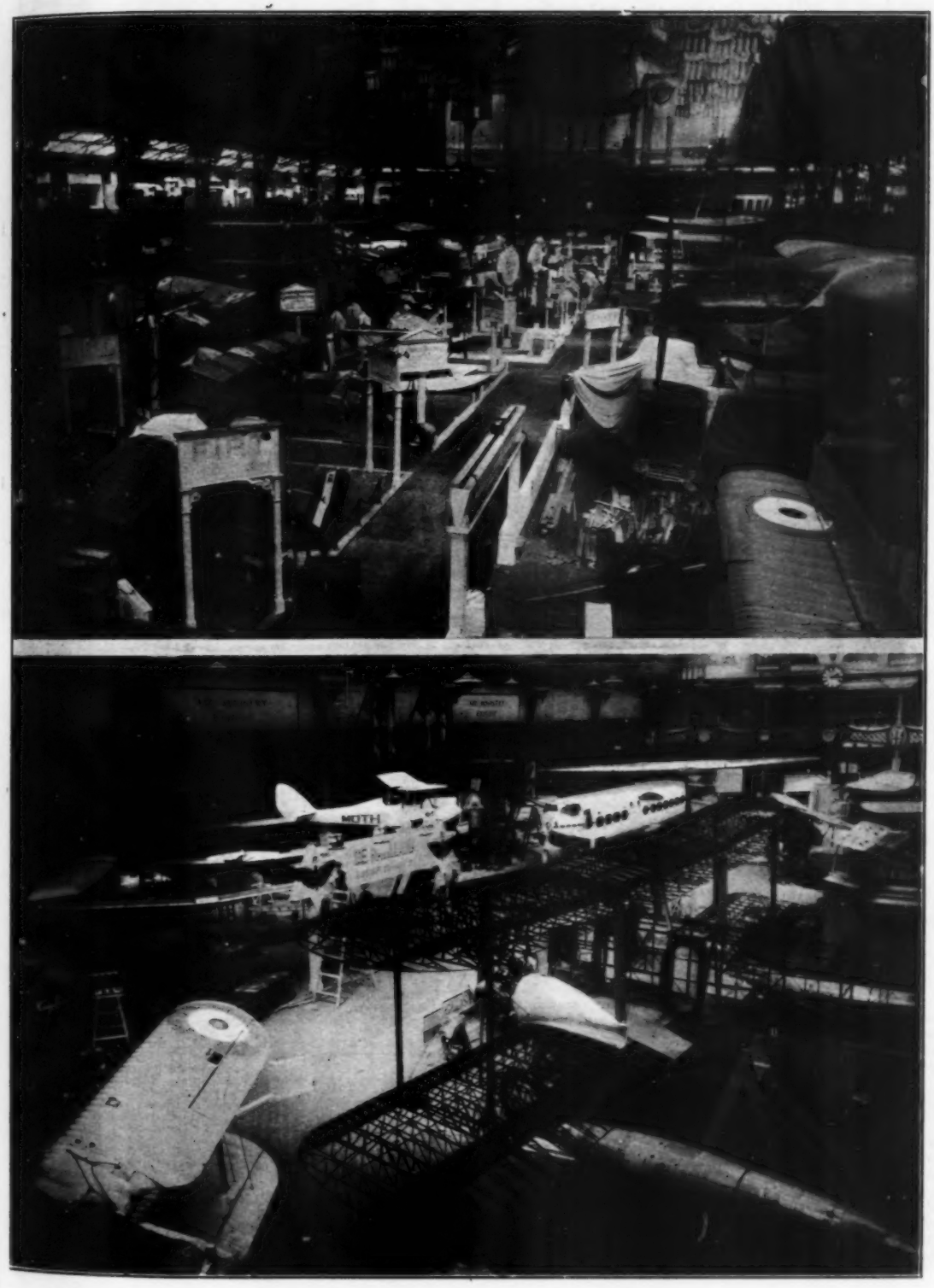
H.R.H. The Prince of Wales declares the Aero Exhibition open.

AT an inaugural luncheon on Tuesday at Olympia, when some 450 guests attended, H.R.H. The Prince of Wales, after a thorough inspection of the exhibits formally opened the 10th International Aero Show at Olympia. So fascinating were the exhibits and so keenly was the Prince interested in everything he saw, that for once, contrary to his usual custom, he broke his record for punctuality and it was about 40 minutes after the appointed time that those invited to meet the Prince were able to give him hearty greeting.

Following this function, H.R. Highness said he thought that those present would be glad to know that that morning

THE GLOSTER AIR SURVEY MACHINE: Contrary to general impression, this machine is for sale, and not built to the order of any particular firm. ("FLIGHT" *Photo.*)

OLYMPIA



Above, a general view in the main hall. Below, a corner of the new hall. ("FLIGHT" *Photos.*)

he was with the King, he was glad to be able to say that His Majesty had not only stood the operation well but was extraordinarily well and had expressed great pleasure to know that he, the Prince, was going to see the Aero Show that day. H.R.H. then, in offering his apologies for being late for the luncheon, said that he could not tear himself away from the exhibits, they were so intensely interesting. It was, he said, the 7th Aero Exhibition in London and was by far the largest and most comprehensive ever held. He was also glad to have the opportunity of welcoming representatives from so many countries of the world. There were exhibits from the United States, from Germany, France, Sweden, Austria, Switzerland, Czechoslovakia and Italy, and it was particularly noteworthy that several countries had arranged special exhibits in addition to the ordinary private exhibitors. He was especially glad to see there that day the French, Belgian and German Ambassadors, Ministers from Sweden, Austria and other nations.

He only regretted the absence of the United States and Italian Ambassadors. The exhibition, he thought, was taking place at a very appropriate time—the 25th anniversary of the Wright Bros.' first flight, the 20th anniversary of M. Bleriot's flying the Channel for the first time, and the 10th anniversary of the first Atlantic flight. And in examining the exhibits, they were a perfect recital of the progress which aviation had made, and so well illustrated by the wonderful exhibits of the Air Ministry and the Royal Aeronautical Society.

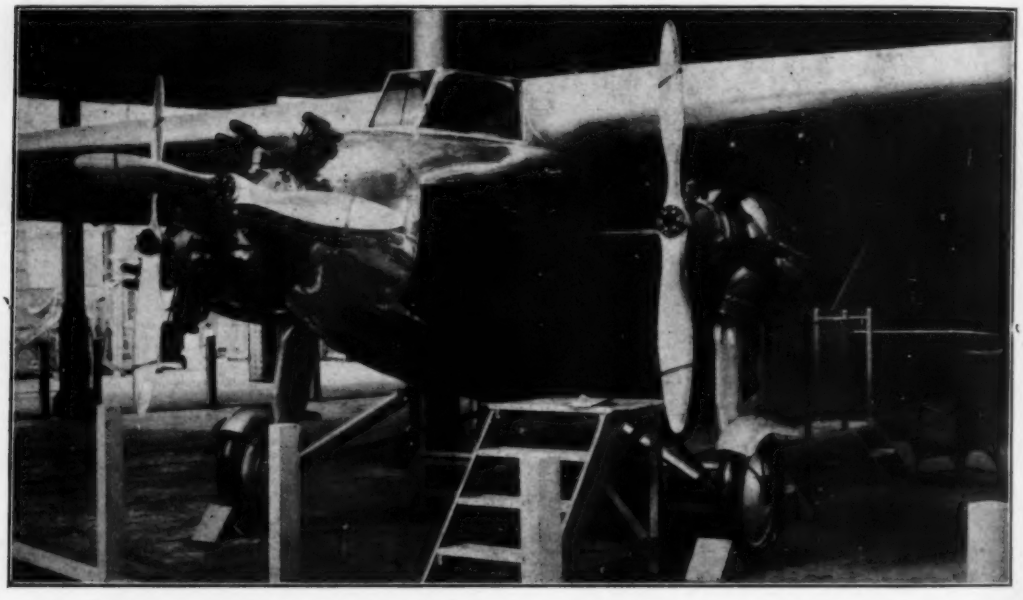
These alone should make us realise the enormous advances made in the science. In fact, we had arrived at a period when we must acknowledge that aviation had now got right into our lives. He would, in conclusion, offer a large measure of praise to the Chairman and the Organising Committee of this wonderful exhibition, and he had great pleasure in declaring open this Great International Aero Exhibition and would ask the company to drink to its success.

Capt. P. D. Acland, the Chairman, in responding, said he wished to express thanks on behalf of the British Aeronautical Community and the many representatives from across seas to His Royal Highness for opening this International Exhibition. The keen interest taken by H.R.H. was but an example of the interest which was shown by the Royal Family in all affairs of the Commonwealth. Capt. Acland then referred to the various great and outstanding British flying events, snayig that aviation was now becoming an integral part of our lives

The moment was therefore appropriate for showing the public what had been done to supply what had become a public necessity. The British constructors were proud to feel that British construction and quality could not be excelled. At the same time they were willing that the best man should succeed. His Royal Highness had by his presence given a splendid send-off to induce the British public to come forward and support the exhibition and the Aviation Industry by their presence.

Amongst those who accepted invitation to be present were:

Capt. P. D. Acland, Mr. C. V. Allen, Prof. L. Bairstow, Capt. H. Balfour, M.P., Maj. T. M. Barlow, Capt. F. S. Barnwell, Mr. A. J. A. Wallace Barr, Lieut.-Col. J. Barrett-Lennard, Sir George Beharrell, Count E. Bernstorff, Mr. F. G. L. Bertram, Sqdn.-Commdr. J. Bird, Maj. P. Bishop, Mr. R. Blackburn, Air Commodore I. M. Bonham-Carter, Sqdn.-Ldr. A. R. Boyle, Air Vice-Marshal Sir W. Sefton Brancker, Mr. H. Brearley, Sir A. Whitten Brown, Mr. R. A. Bruce, Maj. J. S. Buchanan, Mr. C. Ll. Bullock, Maj. G. P. Bulman, Maj. F. A. Bumpus, Mr. H. Burroughes, Mr. A. S. Butler, Brig.-Gen. W. B. Caddell, Air-Commodore J. A. Chamier, Capt. L. Charley, Don Juan de la Cierva, Air Commodore R. H. Clark-Hall, Maj. C. K. Cochran-Patrick, Lieut.-Col. H. W. G. Cole, Col. M. O. Darby, Sir A. Trevor Dawson, Mr. T. A. Dennis, Capt. G. de Havilland, Air Vice-Marshal H. C. T. Dowding, Mr. S. F. Edge, Lieut.-Col. Ivo Edwards, Viscount Elibank, Air Vice-Marshal Sir E. L. Ellington, Sqdn.-Ldr. England, Mr. C. R. Fairey, Mr. A. H. R. Fedden, Group-Capt. P. Fellowes, Mr. H. G. fiske, M. de Fleuriau, Baron, G. Frackenstein, Group-Capt. N. J. Gill, Mr. A. Gouge, Maj. F. M. Green, Wing-Comdr. L. Greig, Wing-Comdr. G. P. Grenfell, Brig.-Gen. P. R. C. Groves, Capt. the Right Hon. F. E. Guest, Mr. A. R. Habersbon, Col. A. Hacking, Sir H. Hambling, Herr Ernst Heinkel, Maj. H. Hemming, Sir J. F. A. Higgins, Mr. S. W. Hiscocks, Air-Commodore F. V. Holt, Maj. G. E. Woods Humphery, Sir Samuel Instone, Prof. B. M. Jones, Mr. O. G. Karlowa, Air Vice-Marshal C. L. Lambe, Capt. A. G. Lamplugh, Mr. W. Lappin, Air Vice-Marshal C. A. H. Longcroft, Messrs. D. Longden, J. Lord, M. Jan Masaryk, Col. J. S. Matthew, Wing-Comdr. R. B. Maycock, Maj. R. H. Mayo, Sir F. McClean, Mr. R. J. Mitchell, Mr. F. Montague, Air Vice-Marshal D. Munro, Air-Commodore C. L. N. Newall, Wing-Comdr. H. R. Nicholl, Sir W. F. Nicholson, Mr. J. D. North, Lieut.-Col. M. O'Gorman, Mr. P. J. Oldfield, Lieut.-Col. H. W. S. Outram, Messrs. F. Handley Page, H. Scott Paine, Baron E. K. Palmstierna, Mr. G. G. Parnall, Capt. J. D. Paul, Mr. H. E. Perrin, Sir E. Petter, Messrs. P. W. Petter, R. K. Pierson, H. E. Pooley, Sqdn.-Ldr. C. A. Ridley, Mr. C. P. Robertson, Sir A. V. Roe, Group-Capt. R. P. Ross, Mr. A. J. Rowledge, Wing-Comdr. W. J. Ryan, Sir J. M. Salmond, Air Vice-Marshal Sir W. G. H. Salmond, Air Vice-Marshal F. R. Scatlett, Lord Herbert Scott, Maj. T. P. Searight, Col. the Master of Sempill, Messrs. H. A. Short, H. O. Short, J. D. Siddeley, A. F. Sidgreaves, F. Sigrist, O. E. Simmonds, F. R. Simms, Gordon Smith, M. de Sonnenberg, Messrs. T. O. M. Sopwith, F. E. N. St. Barbe, Sqdn.-Ldr. L. F. Stevenson, Maj. J. Stewart, Dr. F. Sthamer, Lieut.-Col. L. A. Strange, Herr Dr. Tetens, Brig.-Gen. the Right. Hon. Lord Thomson of Cardington, Lieut.-Col. N. G. Thwaites, Mr. H. T. Tizard, Sir H. M. Trenchard, Bart., Mr. H. T. Vane, Maj. O. G. G. Villiers, Sir Vyell Vyvyan, Sir C. C. Wakefield, Bart., Mr. C. C. Walker, Air-Commodore J. G. Weir, Sir G. Stanley White, Bart., Sir H. White-Smith Mr. H. E. Wimperis, Sqdn.-Ldr. H. N. Wrigley, etc.



AN ATTRACTIVE PROPOSITION: The Avro 5 is a small three-engined cabin machine fitted with Genet Major engines. ("FLIGHT" *Photo.*)

BRITISH AERO ENGINES at OLYMPIA

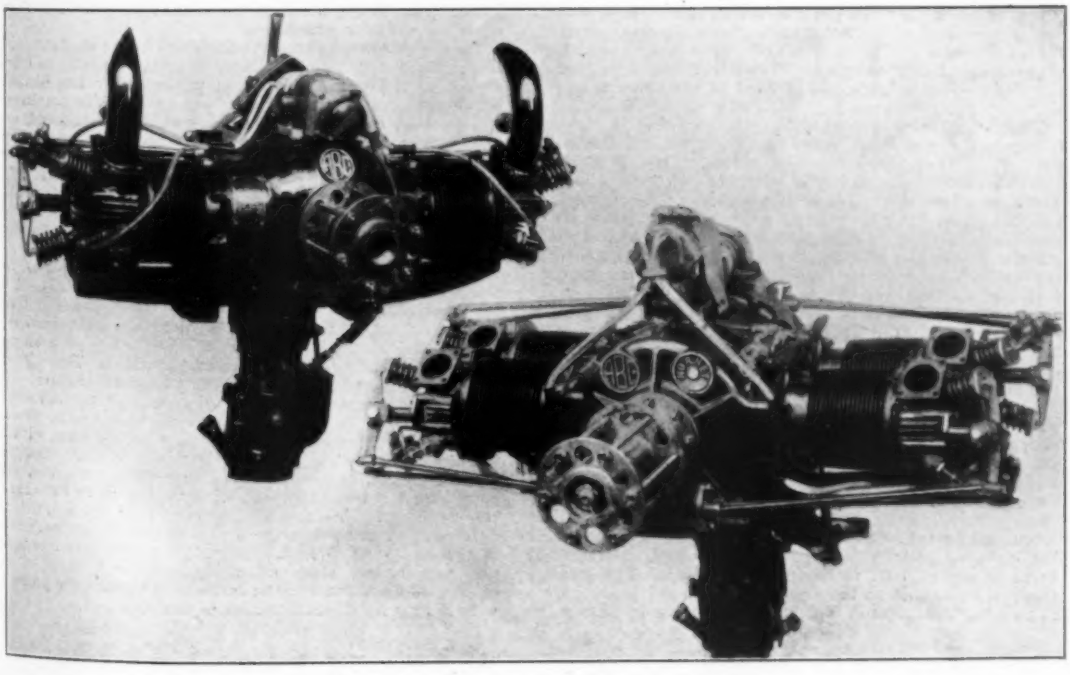
A.B.C. MOTORS, LTD.

THE arrival of the light aeroplane, in more than one sense of the word, has caused a number of new small power-units to appear on the market recently, conspicuous among these being the "Scorpion" and the "Hornet" produced by the A.B.C. Co., of Walton-on-Thames. It should be observed that the production of aero-engines by this firm is not a new departure, for seventeen years ago, which is a long period in the history of aviation, the late H. G. Hawker established a world's duration record with a flight of nearly 8½ hours in an aeroplane fitted with an A.B.C. engine. Furthermore during the last two years of the War four types of engines were produced by this firm, these ranging from the 40 h.p. "Gnat" to the 320 h.p. "Dragonfly." The re-entry of this old-established firm into the field, or more correctly the air, will therefore be welcomed alike by producers and users of light aeroplanes.

The A.B.C. Co. are specialists in the design of the air-cooled, horizontally opposed, engine, and two examples of this type are being shown at Olympia, the Scorpion being a twin-cylinder model, whilst the Hornet is a four-cylinder engine which may be regarded as being a "double Scorpion." The Scorpion is intended for installation in single-seater aircraft of the lightest type, the engine giving an output of 34 b.h.p. at a normal crankshaft speed of 2,300 r.p.m., the maximum power and speed for short intervals being 40 h.p. at 2,750 r.p.m. The fuel consumption is 0·52 pint per b.h.p and the oil consumption is 0·04 pint per b.h.p.-hour respectively.

As the Hornet comprises the main elements of two Scorpion engines, mounted in tandem about a common crankcase, it will suffice to deal with the details of the twin-cylinder engine, following with further particulars of those items in which the four-cylinder engine differs. The bore and stroke, 102 mm. and 122 mm. respectively, and the compression ratio are the same for both engines, the cylinders and pistons being interchangeable.

The cylinders have detachable cast-iron heads, these being bolted to steel barrels which are machined from the solid, the fins of the latter being turned concentric with the bores. The top of the combustion chamber is of hemispherical form and accommodates one inlet and one exhaust valve, Two sparking plug sockets are provided, these being diametrically opposed. Each cylinder is spigoted into the crankcase, to which the flanged inner ends of the barrels are secured by four bolts. The valve rockers are carried by two forked brackets which are bolted to the head. The diametrically opposed induction and exhaust pipe flanges are cast integral with the head the induction flange being on the



THE A.B.C. ENGINES : On the left, the Two-cylinder Scorpion, and on the right, the Four-cylinder Hornet.

underside of each and located slightly to the rear of the vertical centre line.

The crankcase is of unusual design in that it consists of a body formed by a single casting, the rear end of which is closed by a flat vertical cover. Furthermore the induction manifold is formed integral with the bottom of the crankcase body, this location serving the dual purpose of heating the mixture in the manifold and cooling the oil in the crankcase. The two cast aluminium induction elbows are fitted into sliding gas-tight joints provided one at either side of the manifold and are bolted to the induction flanges on the cylinder heads. The forward end of the crankcase is of hemispherical form, whilst the rear cover is circular and is spigoted into the body. The top of the crankcase is made flat to provide a suitable platform for the mounting of the magneto.

The one-piece crankshaft is machined from a high tensile steel stamping, the two crank throws being at 180°, with the crankpin widths kept as small as is consistent with the provision of ample bearing area, so that the offset of the bores and the resultant couple is reduced to the minimum. The crankshaft bearings are thus placed as closely together as possible, providing a very short, stiff shaft and reducing vibration to a minimum. Roller bearings are employed for the support of the crankshaft, the thrust being taken by a ball-bearing which is located between the two roller bearings at the forward end of the crankshaft. The engine is designed to drive a tractor airscrew normally, but it can be supplied for driving a propeller if required, and has in fact actually been used in aircraft of the pusher type. The airscrew is directly driven, the hub being secured to the forward extension of the crankshaft.

The connecting rods are stampings of the same material as the crankshaft and are of unusually light construction. The big-ends are formed integral with the rods, the bearings being of the plain floating-bush type of unusual design. The bronze bushes are split, each half being placed in position after the big end has been threaded over the crankpin, the halves then being joined by steel screws which are secured by locking wires, the bush joints being so arranged that the bearing load does not tend to burst them. Oil ducts are formed in the crankshaft to supply oil to the big end bearings under a pressure of from 40 to 60 lbs. per sq. in.

The aluminium alloy pistons are provided with one compression ring only, a special form of oil scraper ring being fitted immediately below this. The crowns are concaved to provide a partially spherical combustion space. The piston walls are relieved for the greater portion of their length between the rings and the bottom of the skirt, the full diameter portion of the latter having two narrow oil grooves turned thereon. A number of oil drain holes are drilled through the piston walls above the full diameter portion of the skirt. The gudgeon pin is fixed to the connecting rod by means of a cotter-pin nut, and split pin.

The camshaft is supported by a ball-bearing in the end cover, and is very short, there being only one inlet and one exhaust cam, each serving two valves. The camshaft is gear-driven by a pinion keyed to the tail of the crankshaft. The tappet bearings are carried in sockets cast integral with the crankcase, one socket at each side. The tappets are of the roller type, the arrangement being side-by-side, horizontally, with the exhaust fitted foremost. The spherical ends of the valve push rods are accommodated in adjustable cups fitted at the ends of the rocker levers. The rockers are mounted on hollow pins which are designed to retain a reserve supply of lubricant, a Tecalemit greaser being fitted to each. The valves are of special high-tensile steel, and are interchangeable. Two concentric steel wire helical valve springs are fitted to each.

Lubrication is on the dry-sump principle, the pressure and scavenge pumps being located on the rear cover of the crankcase. The oil is fed to a plain bush on the tail shaft, this being located in the cover, and passes thence through the usual oilways to the big-end bearings. The two pumps are of the same size and are of simple design, each comprising three working parts only. The pistons and gudgeon pins are lubricated by splash from the excess oil thrown off from the big ends. A detachable and easily accessible strainer is fitted in the oil lead to the pressure pump. The pressure pump is connected to the crankshaft rear-end bearing by a short lead, the union of which incorporates a by-pass valve which allows the excess oil to return directly to the top of the tank. A union is also provided to which the pressure gauge lead is connected.

A specially-designed double-choke, triple-diffuser type Zenith carburettor is fitted. It is bolted directly to the bottom of the crankcase, the latter having the intake manifold cast integral as previously described. The intake air is heated by muffs which are connected to the exhaust elbows.

One Watford four-terminal magneto, specially designed for the engine, supplies the two plugs of each cylinder. Although this arrangement does not give dual ignition in the accepted sense, it does provide a greater immunity from ignition failure than would be possible if the single magneto supplied only one plug per cylinder. The magneto is mounted on top of the crankcase with the contact breaker facing forward. The magneto is provided with an impulse starter and variable timing, the control lever for which is interconnected with the throttle lever, so that full advance is obtained at or above quarter throttle opening.

The Hornet gives rather more than double the power of two Scorpions, as it develops 75 b.h.p. at 1,875 r.p.m., and 82 b.h.p. at 2,175 r.p.m., the fuel consumption being 0·53 pint per b.h.p. per hour, while the oil consumption is 0·035 pint per b.h.p.-hour. The cylinder dimensions and construction are the same as those of the Scorpion, but the arrangement of the valve rockers on the front pair of cylinders has been changed so as to bring the push rods to the front.

The centre portion, or body, of the crankcase is cylindrical, the ends being closed by covers which are bolted to flanges formed at each end. The crankcase body is provided with a plain bearing for the support of the crankshaft between the two crankthrows. As on the Scorpion, the induction manifold is cast integral with the bottom of the crankcase body, to which the carburettor is directly attached, whilst the top of the casting is provided with a mounting for the magneto. A sump and detachable strainer are fitted in the bottom of the crankcase, a lead being taken from the sump to the suction side of the scavenge pump, this being located at the port side of the rear end cover. The latter forms a gear-case accommodating all the auxiliary drives. The rear cover supports the end of the crankshaft in a roller bearing, and houses the cam gear for the valves of the rear cylinders; the pressure and scavenge pumps are also fitted to the cover. The detachable front cover houses the timing gear and tappets for the valves of the front cylinders, the cam box being located immediately below the double-thrust bearing. Cast aluminium branched induction pipes convey the mixture from the induction manifold to the cylinder heads, a simple sliding joint being fitted at the crankcase end of each to allow for cylinder expansion.

The two-throw crankshaft is machined from a steel stamping and is fitted with bronze balance weights on the outer crank cheeks to neutralise the couple produced by the distance between the centres of the crankpin loads. The crankshaft is supported by two roller bearings at its forward end, and one at the rear end, the double-thrust bearing is fitted between the two foremost bearings. The plain centre bearing is supported at the centre of the crankcase. The crankpin and centre bearings are case hardened, but the remainder of the shaft is left soft, the heat treatment applied for hardening purposes increasing its tensile strength throughout.

The four similar connecting rods have split big-ends, but the special bush arrangement is the same as that used on the Scorpion. The big-end caps are each secured by two bolts. The big-ends of each pair of rods are fitted side-by-side on their common crankpin, the centre lines of each pair of cylinders being therefore slightly offset. The pistons, gudgeon pins and fixing bolts are all interchangeable with those of the Scorpion, as are also the valves, tappets, rockers, and push rods. The lubrication arrangements are also similar.

Ignition is provided by a Watford magneto fitted with an impulse starter. The magneto has been specially designed for the engine, and is provided with eight terminals, thus supplying the two plugs of each cylinder, as in the case of the Scorpion. The carburettor is also of the same type, enlarged to suit the increased capacity of the engine. Four steel tubes are fitted, horizontally, to the crankcase, two above and two below, these extending rearwards clear of the engine, to form bearers, the rear ends of which are provided with flanges for the attachment of the bulkhead.

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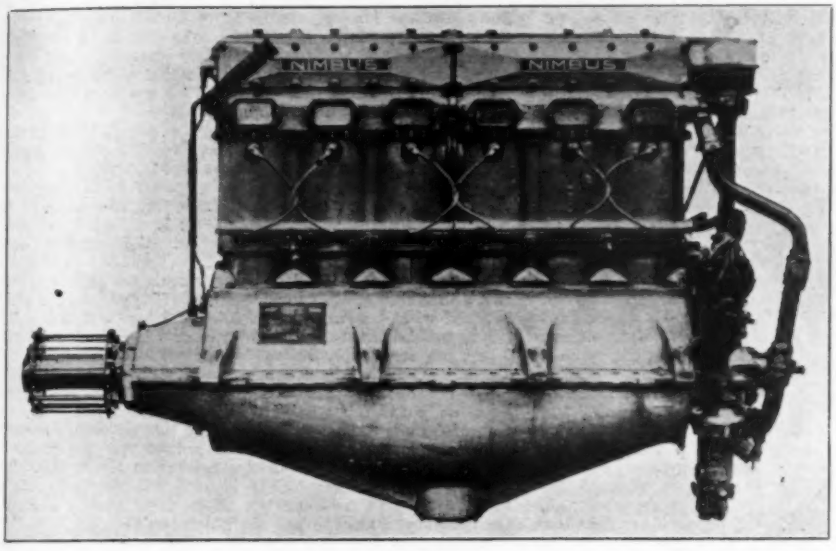
A.D.C. AIRCRAFT, LTD.

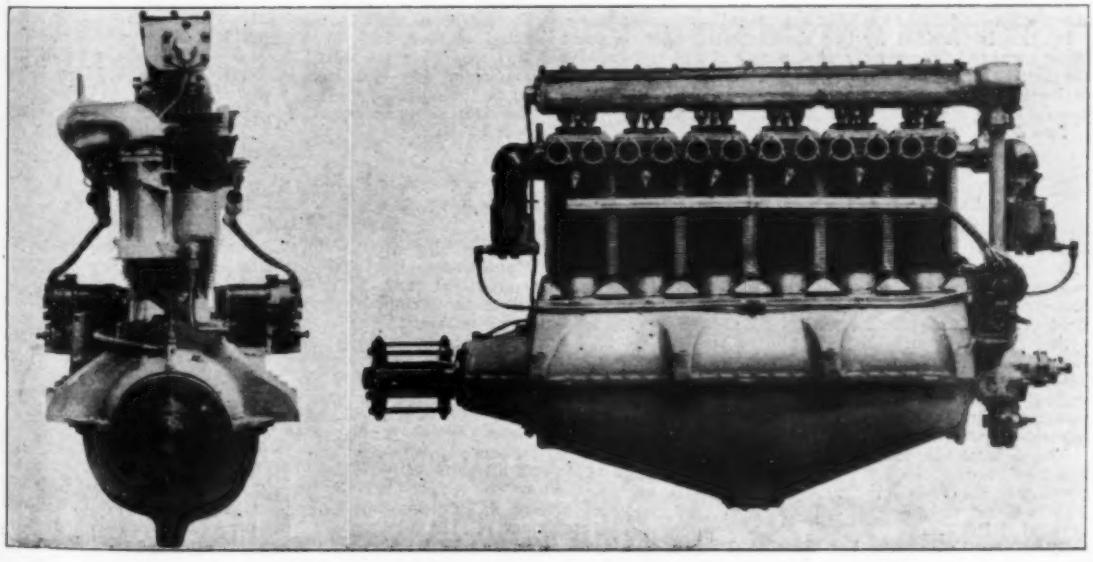
A.D.C. AIRCRAFT, LTD., are showing two six-cylinder in-line engines, namely, the evergreen watercooled Nimbus and an entirely new engine air-cooled which has been named the Airsix. These two engines are the only two normal petrol engines of the six-in-line type among the British exhibits, the sole survivors of a type which was at one time extremely popular but has since been superseded by more powerful engines of the V and radial types or, in the lighter class, by the four-in-line or small radial engines. For medium powers, however, the type seems likely to remain indefinitely, mainly on account of its small frontal area and ease of installation.

The Nimbus has a normal output of 305 b.h.p. at 1,450 r.p.m. and a maximum output of 332 b.h.p. at 1,600 r.p.m., the airscrew being directly driven. The petrol and oil consumption at normal output is 0·52 and 0·017 pints per b.h.p. hour respectively. The bore and stroke are 152 mm. and 190 mm. respectively. This engine is famous for its stolid reliability and ease of maintenance and was on account of these qualities selected for service in the Colonies by various aerial survey organisations. The Nimbus is probably better known and appreciated abroad than at home, for it has in the tropics established a wonderful record of unbroken service under the most arduous conditions imaginable.

The cylinder construction is of the type in which closed-ended steel barrels are screwed into aluminium water jacket castings, these being divided into two blocks of three each. An aluminium head casting, having integral induction and exhaust passages, is secured to the flat cylinder heads by the valve seats, these being screwed into the head casting from inside the cylinders. One inlet and two exhaust valves are



THE A.D.C. NIMBUS: Exhaust Side.



THE FIRST BRITISH SIX-CYLINDER IN-LINE AIR-COOLED AERO ENGINE : Front and side views of the Airsix recently introduced by A.D.C. Aircraft, Ltd.

provided in each head. To the head casting of each cylinder block is bolted a further aluminium casting, this forming the top of the head water jackets and the valve gear housing. The tops of the main water jacket blocks are bolted to the head castings, the water spaces in the heads leading into those surrounding the barrels, whilst the screwed joints between the barrels and the bottoms of the blocks are each made water-tight by a rubber ring which is compressed and secured by contracting and locking rings. The cylinders are spigoted into the crankcase and are secured by claws which engage with flanges turned on the barrels.

The aluminium crankcase is in two portions, the joint being on the crankshaft, centre line. Five transverse webs, cast integral with the top half, support the crankshaft bearing housings. The eight supporting feet and two brackets for mounting the magnetos at the rear of the engine are also cast integral with the top half. The lower half of the crank-case is made deep at the centre to form an oil reservoir.

The crankshaft is a one-piece forging and is supported by seven plain bearings, a roller bearing being fitted at the extreme forward end. The forged connecting rods are provided with split bushed big ends and are secured to the cast aluminium alloy pistons by fully floating gudgeon pins. Each piston carries four rings, three compression and one scraper.

The auxiliary drives are all located at the rear end of the crankshaft and are very simply arranged. The single cam-shaft is bevel driven by a shaft fitted at the rear of the engine. As the camshaft is situated directly over the exhaust valves, the driving shaft is inclined slightly to the port side. A down-ward extension of this shaft drives the water pump, the casing of which is bolted directly to the under side of the auxiliary drive casing, whilst above the driving bevel the short magneto-driving cross-shaft is driven by a spiral gear from the camshaft driving shaft.

The dual oil pump is driven by the lower end of the water pump spindle, the casing of the oil pump being directly bolted to that of the water pump. The oil pump supplies the crankshaft main bearing journals through an external distributing pipe located at the starboard side of the crankcase, a filter being fitted at the rear end. Oil passes into the hollow crankshaft via the main bearings and so reaches the big end bearings, from which it is splashed on to the cylinder walls, the excess oil draining directly into the reservoir.

The camshaft operates the pairs of exhaust valves directly, whilst the single inlet valves are each operated through a rocker. A branch lead from the main oil distributing pipe supplies oil to the forward end of the camshaft the surplus oil being drained into the crankcase through the tubular casing surrounding the camshaft driving shaft.

The water is forced by the centrifugal pump through a lead incorporating two flexible joints to the port side of the head casting at the rearmost cylinder, the outlet being on the same side at the forward end of the front block. The water passes from the rear to the front block through large passages located at the adjacent faces of the head and main jacket castings.

Ignition is provided by two six-terminal magnetos, these being mounted transversely at the rear of the engine with the distributors facing outwards. The two sparking plugs of each cylinder are fitted horizontally into the sides of the combustion space, diametrically opposite each other.

Two Zenith type 65 G. carburettors are fitted, these being bolted directly to a water-jacketed induction manifold cast integral with each cylinder block, on the starboard side.

The Airsix is a medium-powered air-cooled six-cylinder-in-line engine. It has the distinction of being the first British engine of this type to be built. In general arrangement it is similar to the Nimbus, and may be considered as an air-cooled version of that engine. The external dimensions and the disposition of and the distances between the bearer centres are the same, making the new engine interchangeable with the old. The power, however, is slightly lower than that of the water-cooled engine due to the reduction of the cylinder bores from 152 mm. to 137 mm. to allow for the finning of the barrels, the distance between the centres of the cylinders and the length of stroke (190 mm.) remaining the same as on the Nimbus, a similar crankshaft and crank-case being used. The normal output is 275 b.h.p. at 1,750 r.p.m. and the maximum output 300 b.h.p. at 1,950 r.p.m., the airscrew being directly driven.

The power has not, however, been reduced in proportion to the reduction in piston area as this has been to a certain extent compensated by a higher crankshaft speed; the out-put per litre has, in fact, been increased by 10 per cent., although the compression ratio is lower than that of the Nimbus, it being 5 : 1 instead of 5·4 : 1. The weight/power ratio remains unchanged, the elimination of the water jackets resulting in a saving of 50 lb.

The closed-ended steel cylinder barrels are provided with cast aluminium heads of the " poultice " type, each of which is fitted with four valves, two inlet and two exhaust. The heads are bolted to the flat tops of the cylinder barrels. The latter are deeply finned for almost their whole length, and are secured to the crankcase in a manner similar to those of the Nimbus. A special form of cowling has been designed to provide for the adequate cooling of the cylinders, this comprising six air chutes, so arranged that the chute for each succeeding cylinder projects further into the airstream. A separate air-stream is also directed on to the heads. The running temperature during recent tests of this engine has proved that it is actually about 40° C. lower than the temperature of the average air-cooled engine.

An unusual feature is that the valves are operated by an overhead camshaft in place of the push rods which have hitherto been universally used on air-cooled aero engines. This has been achieved by a very neat form of construction in which the camshaft and rocker gear is completely encased in an aluminium casting which is supported by studs screwed into the steel portion of the cylinders, the cam casing being mounted well clear of the heads to provide sufficient air space for efficient cooling. The valves are operated by vertical tappets which have their bearings in the camshaft housing, the single camshaft bearing directly on the exhaust valve tappets, whilst the inlet valve tappets are operated through rockers.

The exhaust-jacketed induction manifolds are fitted at the starboard side, a Zenith type 65 G carburettor being fitted at each end, each supplying three cylinders. The two magnetos are fitted transversely at the rear of the crankcase, the arrangement of the auxiliary drives being as on the Nimbus, excluding the water pump and oil pump, the latter being fitted directly to the underside of the auxiliary gear housing.

ARMSTRONG SIDDELEY MOTORS, LTD.

MESSRS. ARMSTRONG SIDDELEY are showing an interesting selection from their comprehensive range of air-cooled radial engines, from the 80 h.p. five-cylinder Genet through the Mongoose, Lynx and Jaguar Series to their latest commercial productions at the extremes of the scale, the 800 h.p. fourteen-cylinder Leopard and the five-cylinder Genet Major. The Leopard has been built for service in heavy load-carrying aeroplanes, and will no doubt prove one of the most interesting exhibits in the Show, for we believe this is the highest-powered radial engine built to date, and is certainly the highest-powered air-cooled engine of any type in existence.

The Genet Major is also of special interest as this engine has been produced to fill the somewhat wide gap which previously existed in this firm's range of engines between the 80 h.p. Genet and the 150 h.p. Mongoose. The Genet Major is rated at 100 h.p.

It will easily be seen that these engines all have a very strong family resemblance, and in fact many of the components are interchangeable. The cylinders, pistons and valve parts for instance, of the Jaguar, Lynx and Mongoose series are all identical, the differences in power of these three engines being obtained by the number of cylinders employed. This system of providing interchangeable components is convenient both to the makers and users, as it permits those employing fleets of aeroplanes fitted with the various types of Armstrong Siddeley engines to carry a much smaller stock of spares than would otherwise be necessary. The convenience to the manufacturers of this system of inter-changeable components is obvious.

Of the Jaguar Series, the 460 h.p., geared engine is shown, whilst the Lynx Series is represented by the 215 h.p. direct-drive engine. The standard 150 h.p. Mongoose is also being shown; this engine has not been produced in geared form. The exhibit is completed by a standard Genet.

The geared Jaguar engine has a normal output of 480 b.h.p. at 2,000 crankshaft r.p.m., and a maximum output of 510 b.h.p. at 2,200 crankshaft r.p.m. The reduction gear ratio is 0·657 : 1. The only important dimensional difference of this engine, compared with the direct-drive type, is that the length is increased by approximately 5¼ in. A point of interest is that although the addition of the gearing results in an increase in weight of 85 lb., the greater power obtained

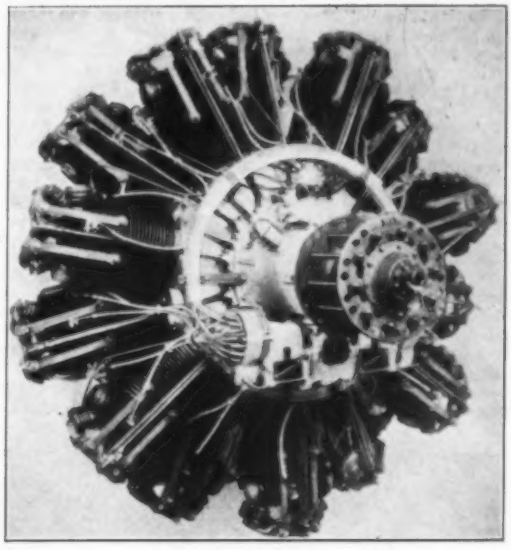
by the higher crankshaft speed made possible by the gearing results in a decrease in the weight/power ratio, this being 1·75 lb. per b.h.p., as compared with 1·84 lb. per b.h.p. in the case of the direct-drive engine. The bore and stroke are 5 in. and 5½ in. respectively, and the compression ratio is 5 : 1.

The cylinders are of composite construction, the barrels being turned from steel forgings whilst the heads are of aluminium, and are screwed and shrunk on to the barrels, where they are each locked by a mild steel ring which forms an additional cooling fin. The combustion chamber is of hemispherical form, and is fitted with two inclined valves, the inlet and exhaust passages being cast integral with the head and arranged side by side, terminating in flanges facing rearwards to which their respective pipes are bolted. The valve seats and the two sparking plug sockets located at the front of the head are of bronze, and are screwed and expanded in position. Each valve has two concentric steel wire coil springs. A feature of interest in the new Jaguar engines, and those fitted with Jaguar type cylinders, is that the valve rockers are now arranged parallel to each other, and are neatly encased by streamlined covers, the grasshopper type of rocker and tappet return springs having been replaced by coil springs which surround the upper ends of the push rods, where they are fitted between the underside of the rocker casing and collars on the push rods.

The pistons are machined from aluminium alloy forgings, and are each provided with two compression rings and one scraper ring immediately below. A chamfered and radially-drilled groove is formed in the piston immediately below the scraper ring.

The method of securing the cylinders to the crankcase forms the subject of a patent, and comprises a screwed and flanged collar, which is screwed to the bottom end of the cylinder barrel, after insertion in the socket, the flange engaging with a lip formed at the lower end of the socket, the assembly being locked by a taper-sectioned contracting ring which is fitted between the bottom fin and an inclined bearing surface provided at the top of the socket. The engine body comprises three main parts, the crankcase, formed by a central cyclindrical portion which houses the crankshaft, the back cover which carries the rear crankshaft bearing, and to which the induction fan casing is secured, and the front portion, which is formed by the reduction gear housing, and carries the airscrew shaft journal and thrust bearings.

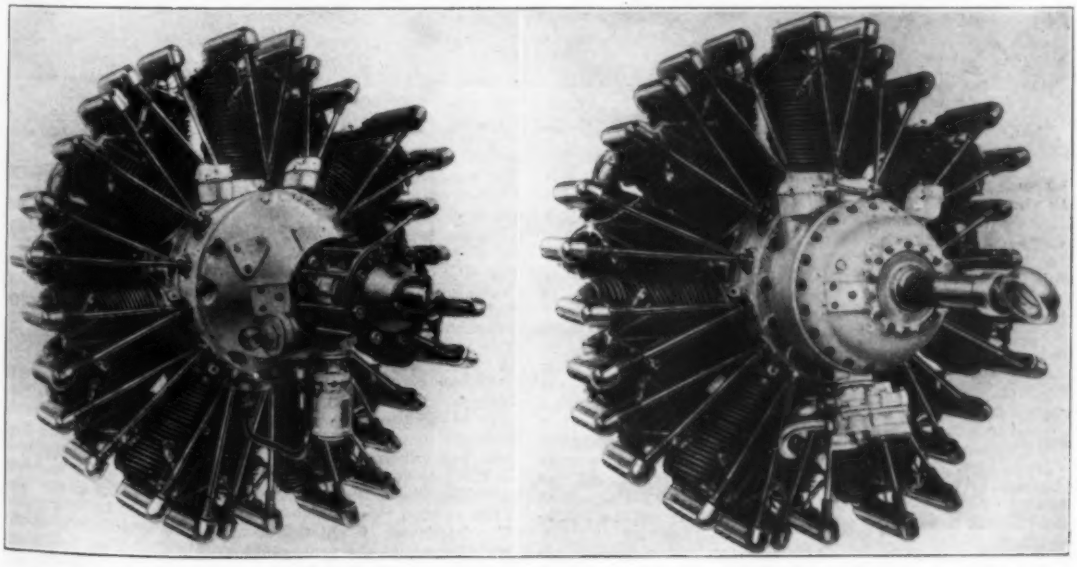
The crankshaft is a one-piece forging, having two crank-throws at 180°. Two bronze balance weights are fitted, one on an extension of each outer crank cheek. The crankshaft is supported between two roller bearings which are located against the outer crank cheeks and are supported by the covers closing the front and rear ends of the crank chamber.



The Armstrong Siddeley "Direct-Drive Leopard."

The valve gear is driven by a pinion fitted to the short forward extension of the crankshaft, the tappets being actuated by a common internally-toothed cam ring unit, which is located forward of the cover closing the front end of the crankcase. This ring is driven by the pinion through two intermediate pinions arranged one above and one below the crankshaft.

The rear end of the crankshaft drives the induction fan and an extension spindle which is fitted with a bevel and drives the magnetos, these being arranged one on either side of the induction gear casing. The connecting rod assembly for each group of seven cylinders comprises one H-sectioned master rod and six articulated tubular auxiliary rods. The big-end bearing of the master rod is of the white-metal lined split type, in which the white-metal is cast directly into the master ring. The master rod is formed integral with the upper half of the master ring, the lower portion being secured by four bolts. The auxiliary rods are each secured between



TWO VERSIONS OF THE ARMSTRONG SIDDELEY " JAGUAR " : On the left the direct-drive engine, and on the right the geared.

the flanges of the master ring by hollow steel pins which are free to float in steel bushes fitted in the webs of the master ring. The six pins are located by circlips. The small-end bearings of the connecting rods are each provided with floating bronze bushes, the pistons being secured to the connecting rods by hollow gudgeon pins of the fully floating type. The gudgeon pins are located endwise by circlips.

The tappets are operated by a cam drum which has three inlet and three exhaust cams formed on two separate rims, the drum rotating at one-sixth crankshaft speed in the reverse direction. The tappets are of the roller type working in guides carried by an extension cast integral with the crankcase barrel.

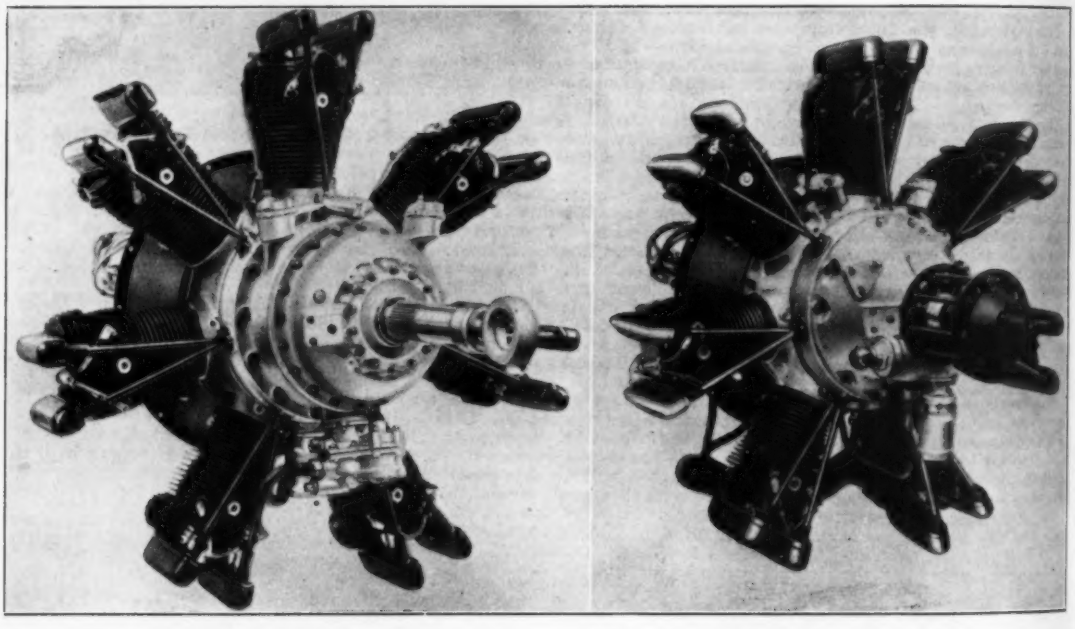
The reduction gear forms a feature of special interest, as it is of so compact construction that it adds very little to the size of the front cover. It is of the simple planetary type and provides a reduction of 0·657 : 1. The gear comprises an internally-toothed ring which is driven at crankshaft speed and meshes with five planet wheels, the axes of which are mounted in a carrier which is secured to the airscrew shaft. The planet wheels also mesh with a fixed sun-wheel, this providing the reaction for the planet wheels. The planet wheels rotate on their axes and roll round the sun-wheel in the same direction as the outer ring, causing the carrier and the airscrew shaft also to rotate in the same direction as the crankshaft but at a reduced speed. The internally-toothed ring is bolted to a hub, which is splined to the forward end of the crankshaft. On the rear face of this hub is a gear wheel which forms the drive for the auxiliaries, *i.e.*, the cam drum and the oil pump spindle. The rear end of the airscrew shaft is spigoted into the end of the crankshaft and is supported by a roller bearing within the hub of the toothed ring, the forward end of the airscrew shaft being carried by a ball bearing in the front cover, this bearing also taking the thrust. Within the front cover is fixed a second internally-toothed ring, this engaging with the forward end of the wide-toothed sun-wheel to secure the latter against rotation. A roller bearing is fitted within the bore of the sun-wheel, in which the airscrew shaft rotates. Each of the planet wheels is mounted on roller bearings. The only excrescences on the gear housing are formed by the two breathers at the top and the oil pumps at the bottom, these being mounted vertically below the crankshaft.

Lubrication is on the dry sump principle, the pressure pump supplying oil through a filter to the centre of the crankshaft and thence to the journal and big-end bearings. A sump and filter is fitted at the bottom of the crankcase into which the oil drains and from which it is evacuated by a scavenge pump fitted below the pressure pump. The scavenge pump has a larger capacity than the supply pump to ensure that the sump is always thoroughly drained. The feed pump draws its supply from a separate tank carried on the aircraft. The scavenge pump which is also provided with a filter, returns it to the tank via a jacket surrounding the carburettor induction elbow and induction fan housing, this system fulfilling the dual purpose of heating the induction elbow and cooling the oil.

The magnetos and carburettor are fitted at the rear of the engine, within the conical mounting plate. The carburettor is bolted directly to the bottom of the induction elbow, the latter being bolted to the centre of the distributing fan housing. The induction pipes lead at an angle from the induction casing and are branched, each branch being connected by short pipes to its respective front and rear pair of cylinders. The two B.T.H. magnetos are directly driven by the bevel fitted at the rear end of the spindle at the end of the crankshaft, the required fine adjustment being provided by a five-keyway system. On all Armstrong-Siddeley engines the ignition timing is fixed.

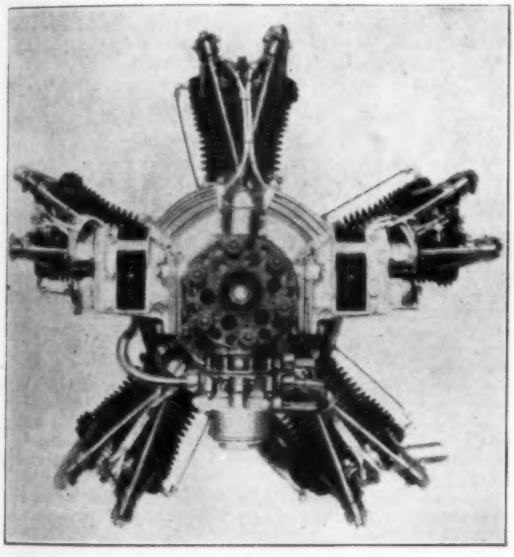
The Leopard is a fourteen-cylinder engine with the cylinders arranged in two staggered groups of seven, as in the Jaguar, but it cannot be said that the Leopard is merely an enlarged version of the Jaguar, for the cylinder head design and valve arrangement is entirely different. The engine shown at Olympia is of the geared type, having a bore and stroke of 6 in. and 7½ in. respectively. The normal output is 815 b.h.p. at 1,700 r.p.m. and the maximum output is 860 b.h.p. at 1,870 r.p.m. The compression ratio is 5 : 1. A similar type of reduction gear as that described with reference to the Jaguar is employed, the ratio being 0·633 : 1. The increase in overall diameter compared with the Jaguar is 12¼ in. only.

Owing to the increased swept volume four valves per cylinder are provided, these being arranged in pairs at either side of the hemispherical combustion head, the stems being inclined outwards from the axis of the bore. The two inlet and two exhaust passages are arranged differently to those of the Jaguar. The exhaust outlets are located at the front of the cylinder head, the exhaust valves being the foremost of each pair, whilst the twin inlet ports face rearwards. The heads are of aluminium alloy and are secured to the steel barrels in the same manner as are those of the Jaguar. The valve seats and sparking plug sockets are also of bronze screwed and expanded into position, two plug sockets being provided in each head at 90° apart, *i.e.*, at the front and side of the head. The arrangement of the valve gear is interesting:



TWO VERSIONS OF THE ARMSTRONG SIDDELEY LYNX : Left, the geared, and right, the ungeared.

each rocker spindle carries one inlet and one exhaust rocker, each push rod having therefore to operate two rockers, one on each spindle. The inner arms of the two rockers operating similar valves are fitted one above the other, the end of one being in contact with the rod on its under side and with the end of the other rocker arm above. The rocker spindles have their rear ends anchored by links to the cylinder head but are supported at their forward ends by a steel bracket, the lower ends of which are secured at the lowest point of the head. The brackets are of special material, having a very low coefficient of expansion. This arrangement provides for temperature compensation in a simple manner and considerably reduces the effect of cylinder expansion on the tappet clearances. The cam and tappet arrangement is similar to that employed in the Jaguar engines, the cam drum having three inlet and three exhaust cams, the drum being rotated at one-sixth crankshaft speed in the reverse direction. The pistons are machined from Y alloy forgings and are also similar in design to those of the Jaguar, having two compression rings and one scraper ring situated above the gudgeon pin, the latter being of the fully floating type.

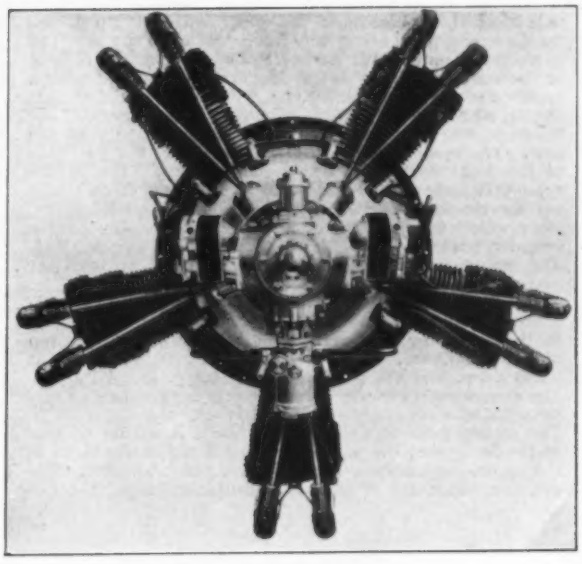


The Armstrong Siddeley Genet.

The crankcase arrangement is similar to that of the gear driven Jaguar, the cylinders being secured in their sockets by the arrangement previously described. The crankshaft is also similar, but the connecting rod arrangement although similar to that of the Jaguar differs in that the auxiliary rods are of H section instead of tubular. The rear end of the crankshaft drives the characteristic mixture distributing fan through gearing instead of directly.

The Claudel-Hobson type A.V.T. 100 carburettor delivers the mixture to the centre of the induction fan housing, the carburettor being bolted to the usual hot oil jacketed induction elbow. Seven branched induction pipes lead from the induction casing, each pipe being further divided near the cylinder heads to connect with the twin inlet ports of each cylinder. A gear-type petrol pump is fitted at the rear of this engine, a revolution indicator drive being fitted above this pump. Provision for priming is made, the priming ring being fitted at the rear of the engine; each branch priming pipe is connected to a small atomizing jet fitted in the induction pipes. Provision is also made for gas starting, the distributor being fitted vertically at the top of the fore part of the timing gear housing. The magnetos are fitted at the rear, where they are bevel-driven by the crankshaft, one on each side as on the Jaguar. The ignition timing is fixed.

The Lynx may best be considered as being "half a Jaguar." Apart from the crankcase body, which is reduced in length as it has only to accommodate a single group of seven cylinders and the single throw crankshaft, practically all the other components of the Lynx are interchangeable with those of the Jaguar. The induction fan casing is modified to accommodate the different induction pipes, these being fitted radially, one at the rear of each cylinder. Each pipe is

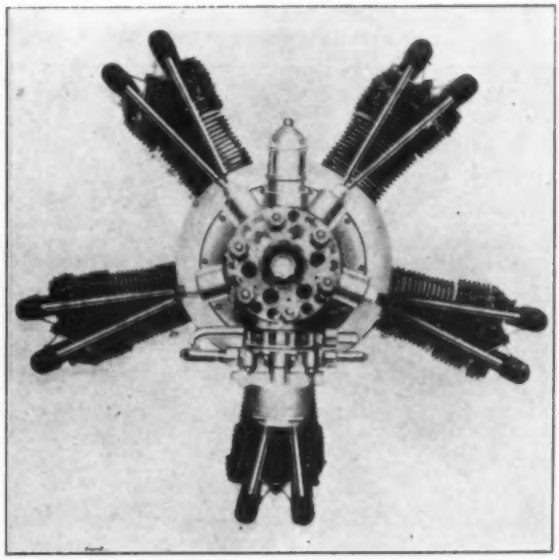


The Armstrong Siddeley Mongoose.

made in two separate portions coupled by a sliding joint to allow for cylinder expansion. The arrangement of the auxiliary drives and the location of the oil pumps, magnetos, etc., is as in the Jaguar. Ignition is provided by two B.T.H. seven terminal magnetos.

The ungeared Lynx is being shown at Olympia, this engine developing 218 b.h.p. at a normal crankshaft speed of 1,900 r.p.m. and having a maximum output of 230 b.h.p. at a crankshaft speed of 2,090 r.p.m. This engine is also available with a reduction gear of the type described with reference to the geared Jaguar. Also it may be fitted with a gear driven supercharger. The compression ratio is the same as that of the Jaguar, namely 5 : 1.

The Mongoose comprises five Lynx or Jaguar cylinders mounted on a common crankcase of considerably smaller size than that of the Lynx, the front cover of which is of entirely different design as in addition to the oil pumps the magnetos are in this engine mounted at the front, one at either side, with the distributors facing outwards. The



The Armstrong Siddeley Genet Major is of quite recent production.

output of the Mongoose is 155 b.h.p. at 1,850 r.p.m. the maximum output being 165 b.h.p. at 2,035 r.p.m. The engine is mounted with the vertical cylinder at the bottom of the crankcase. The new rocker arrangement and covers, as fitted to the Jaguar and Lynx, will also be found on this engine. The two Watford five-terminal magnetos are bevel driven and have their axes inclined slightly to the rear. The revolution indicator is situated at the port side of the front cover just below the magneto. The Zenith type 65 G carburettor is bolted to an induction elbow which supplies the mixture to the centre of the induction fan housing, from which the five induction pipes lead radially to the cylinder heads in a manner similar to those of the Lynx. The induction elbow is jacketed by the warm oil from the scavenge pump as on the other engines.

The Genet is similar to the Mongoose in general arrangement, but differs in having a 4 in. bore and stroke, and in the mounting, the vertical cylinder being at the top of the crankcase. The normal output is 82 b.h.p. at 2,200 r.p.m. and the maximum is 88 b.h.p. at 2,420 r.p.m. The compression ratio is higher on this engine than on any other of the Armstrong-Siddeley range, namely 5·25 : 1. The arrangement of the auxiliary drives is similar to that of the Mongoose, the magnetos being fitted at the front of the engine in addition to the oil pumps and filter. The cylinder heads are of somewhat different design, the two sparking plugs being fitted side by side at the front of the head. The method of securing the cylinder heads to the barrels and the barrels to the crankcase is, however, similar.

The comparatively diminutive Claudel-Hobson type A.V.48 B carburettor is bolted directly to the induction fan casing, the centre portion of which is jacketed by the warm oil from the scavenge pump. The pistons are of slightly different form to those of the larger engines as they have the scraper ring located at the bottom of the skirt. Ignition is provided by two B.T.H. five-terminal magnetos.

The Genet Major, as previously stated, has been designed to fill the gap between the Mongoose and the Genet. It has slightly larger cylinders than the Genet, the bore and stroke being 4·25 in. and 4·5 in. respectively, whilst the compression ratio is 5·2 : 1. The normal output is 103 b.h.p. at 2,200 r.p.m. and the maximum output is 110 b.h.p. at 2,420 r.p.m. The arrangement of the cylinders is similar to that of the Mongoose, *i.e.*, the vertical cylinder is at the bottom of the crankcase. The front cover differs from that of the Genet, the magnetos being fitted at the rear of the engine. This is presumably to allow the engine to be fitted with the standard form of epicyclic reduction gear, as a geared type is available; the engine shown at Olympia is direct driven. Apart from these differences the engine is generally similar to the Mongoose, including the housing of the valve rockers in the new type covers.

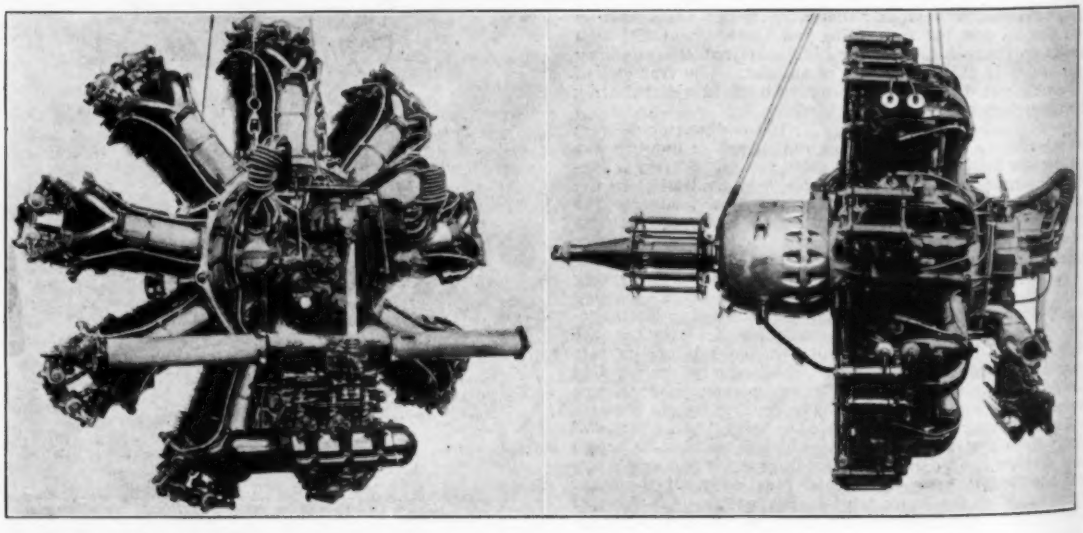
THE BRISTOL AEROPLANE CO., LTD.

ON the Bristol stand are shown representative engines of the new "F" class Jupiter series in the three main types, direct drive, geared and supercharged. Each of these engines incorporates the new cylinder design which forms the main distinguishing feature of the "F" class. Two new engines, the seven-cylinder Neptune and the five-cylinder Titan, are also being shown and will probably excite as much interest and admiration as the rejuvenated Jupiters. Apart from these attractions, it is certain that the superb workmanship and finish that characterises the products of this firm will make the Bristol engine stand the centre of an admiring crowd.

Owing to the world-wide popularity of the Jupiter in its various forms, the latest improvements as incorporated in the "F" class will attract even more attention to this engine, more particularly as the greatest innovation forms a radical change in design policy, namely, the adoption of the open-ended cylinder barrel fitted with a separate head in place of the type of cylinder in which a head casting is fitted over a flat head formed integral with the barrel. There have also been incorporated in the new Jupiters detailed improvements to the induction system and various engine accessories, which together with the new cylinders, have resulted in the achievement of a higher rating and even improved endurance capabilities. The new class of engine has successfully completed the Air Ministry's 100-hours' type test, the new official ratings having been determined from the results of these tests.

The Jupiter VI F is available in three forms, of which at least one representative will be shown, but as the difference is one of compression ratio only it will suffice to deal with only one of the type, as externally they are indistinguishable. The Series VII F, *i.e.*, the supercharged engine of the new class, will also be shown, the Jupiter exhibits being completed by a representative from the geared type, three forms of which are available, these also differing only in compression ratio. The bore and stroke of all these engines, which are, of course, of the nine-cylinder radial type, is 5¾ in. and 7½ in. respectively.

Whereas in the Series VI engines the high, medium and

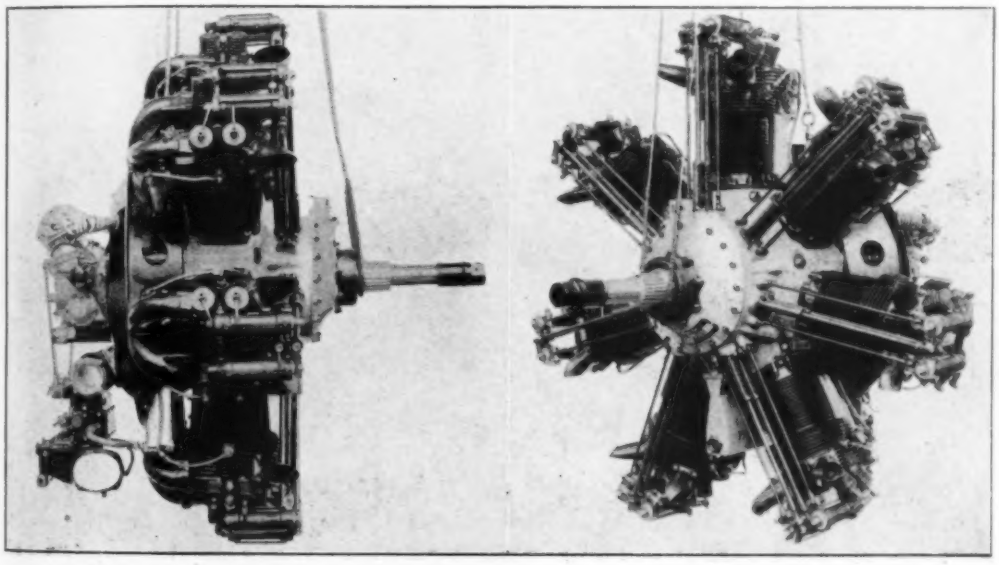


THE BRISTOL GEARED JUPITER VIII F : This engine incorporates the new type of cylinder.

low compression types are designated by the letters H., M. and L. respectively, the geared engines have different series numbers according to compression ratio, namely, VIII, IX and XI, for the high, medium and low compression types. A description of one of the geared engines will therefore suffice as they also are identical externally. It should be observed that both the direct drive and geared high compression engines are known as " Standard Service " types, the compression ratio being 5·8 : 1 ; the medium compression engines are known as the " General Purpose " type and have a compression ratio of 5·3 : 1, whilst the low compression ratio engines are known as the " Commercial " type and have a compression ratio of 5·1 : 1. The supercharged engine has a medium (5·3 : 1) nominal compression ratio.

Before dealing with the features of the individual engines, it will be of interest to consider the cylinder design, as the new form has been standardised on the full range of Jupiter engines, as from June, and will also be found on the other Bristol engines exhibited at Olympia. The decision to change from the " poultice-head " to the open-ended barrel having an aluminium head forming the top of the combustion chamber followed from the extensive development work carried out by the firm's research and experimental departments since the improved light alloys suitable for forging have become available. In addition to the greatly improved gas-tight throughout the life of the cylinder, for it will be understood that the assembly is intended to be permanent, the engaging screw threads are machined with an " interference " fit, the head being heated above the normal working temperature before assembling it to the barrel. The inner end joint is sealed and the thread protected by a copper ring located between the head and a counter bore at the bottom of the thread. A steel ring in the form of an additional fin is finally shrunk on to the outside of the screwed portion of the head to increase the effectiveness of the joint.

The inclined valves, resulting from the new form of combustion head, have caused the valve rocker gear to be entirely redesigned and, as the rockers rotate about a fore-and-aft axis instead of the pivots being arranged transversely as hitherto, the well-known Bristol temperature-compensating gear cannot be employed. A simple and effective method of neutralising the effect of cylinder expansion has, however, been devised. The rocker spindles are mounted in a carrier forming a complete detachable unit, which is hinge-jointed to the cylinder head towards the rear end of the carrier, whilst the front end is anchored to the crankcase by two adjustable tie rods. As the two push rods make contact with their respective rocker arms at the anchored end of the rocker spindle carrier, it will be apparent that the lengthening of the cylinder when hot will not appreciably affect the



A NEW BRISTOL AERO ENGINE : The Neptune I is a 7-cyl. radial using the same cylinders as the Jupiter F.

cooling due to the head being in direct contact with the products of combustion, the improved shape of the combustion head made possible by this form of construction has resulted in a marked increase in output per cylinder.

The cylinder barrel is machined from a carbon steel forging, the fins being turned integral and concentric with the bore, and is screwed at its upper end to take the cylinder head. An integral flange similar to that of the earlier cylinders is provided to take the eight holding down bolts, the lower end of the barrel having a long spigot which fits into the socket in the crankcase. The head is machined from an aluminium " Y " alloy forging, the fins being milled and turned from the solid rough-forged block. The design and finish of the head is worthy of close inspection for it is indeed an outstanding example of the wonders that may be accomplished by modern workshop equipment. The head accommodates four inclined valves, the combustion head being of the " pent-house " form, each slope having one inlet and one exhaust valve seating and a sparking plug socket which is fitted in the centre of the lower portion. The inlet valves are fitted at the rear, the twin inlet ports facing directly rearwards, whilst the exhaust ports are inclined outwards at the front of the head. Each of the four inlet and exhaust ports are faced to receive their respective pipe couplings. The valve seats are of special bronze alloy, screwed, shrunk and peened into the heads. To ensure that the joint between the barrel and the head will remain clearance between the push rods and the rocker arms or tappets. Each push rod operates two inner rocker arms, the spherical end of the rod bearing in the hardened cup of one arm, whilst a hardened spherical-ended pin fitted to the second arm bears on the top face of the end of the lower arm. The push rods are fitted one behind the other, the inlet valve rod being foremost. The inlet and exhaust rockers are arranged concentrically, the arms of each exhaust valve rocker being formed integral with a steel sleeve which is fitted over the spindle to which the arms operating the inlet valve are secured. It is of interest to note the arrangement of the rocker arms relative to the points of support of the spindle carrier, these pin-joined supports being located at each end, between the pairs of rocker arms. The two arms of each exhaust valve rocker are located within the points of support, whilst those of the inlet valves are outside ; but for this arrangement the hinged mounting of the rocker carrier would cause a slight increase in clearance to occur between the ends of the inlet valve rocker arms and the valve stems and a decrease in clearance at the exhaust valve stems. Although this slight change must in fact occur it is compensated by the arrangement of the forward point of support, as at this end the lengthening of the cylinder tends to reduce the clearance between the inlet valve push rod and the arms which it operates, whilst it tends to increase the clearance between the exhaust push rods and its respective rocker arms, thus the overall amount of clearance between the tappets

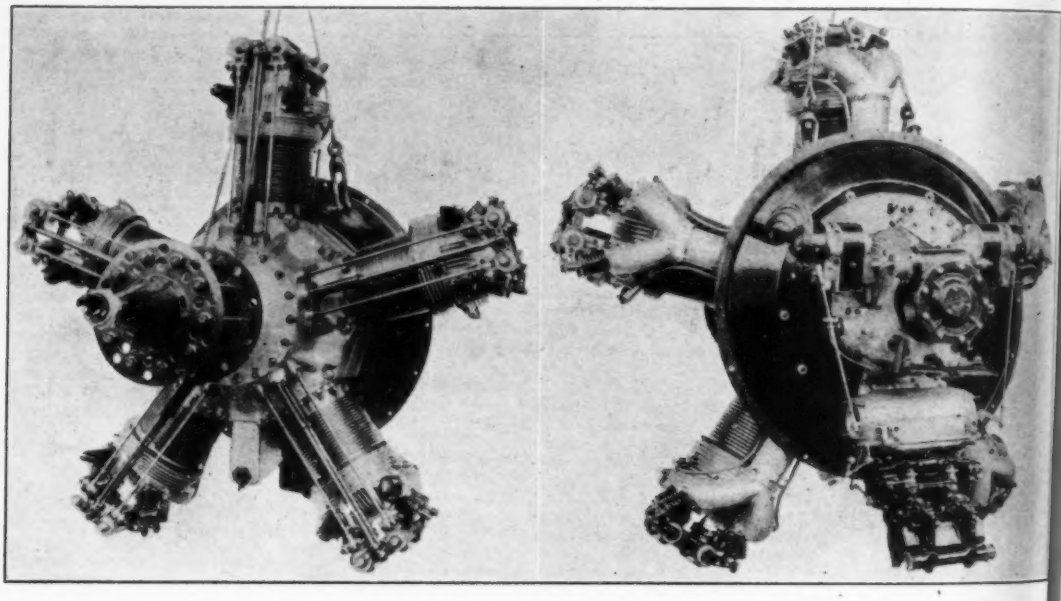
and the ends of the rocker arms in contact with the valve stems is maintained approximately constant. Adjustment is provided for by screwed pins and lock nuts fitted at the ends of the valve-operating arms. The central spindle of each pair of rockers is provided with a Tecalemit grease gun nipple at its forward end.

Each valve stem is surrounded by three concentric springs, the inner one being a volute of thin spring steel strip forming a cover which excludes dust and moisture from the valve guides; the outer springs are of the normal coil type. The springs are retained at their outer ends by a collar which is secured to the valve stem by the usual split-cone device. Into the end of each stem is fitted a hardened steel button on which the rocker arm bears. A circlip is fitted to each valve stem to prevent the valve from falling into the cylinder in the event of the failure, or due to the faulty assembly, of the valve spring securing arrangements.

The F class engines are fitted with the Bristol spiral distributor which ensures the even distribution of the mixture from the Triplex carburettor, but this has been improved by the employment of six deflectors instead of the three previously used, the new arrangement reducing by approximately 25 per cent. the length of the spiral passage through

the airscrew shaft, forward crank cheek and crankpin being formed integral, whilst the rear crank cheek, formed integral with a short shaft for driving the auxiliaries, is keyed and clamped to the rear end of the crankpin. Balance weights are fitted to extensions of the crank cheeks. The airscrew shaft is supported by two journal bearings, the foremost one being a double row spherical roller bearing housed in the crankcase cover, this bearing also serving as the thrust bearing.

The connecting rod assembly is of the type in which a master rod having an integral big-end has the eight auxiliary rods secured thereto by articulated joints. The two-piece crankshaft design permits the integral big-end construction, the ring being fitted with a hardened steel liner which bears on a floating bush fitted between the ring and the crankpin. The auxiliary rods are secured between the end flanges of the master ring by hardened steel pins. The cast aluminium alloy pistons are of the slipper type, the gudgeon pins being supported by bosses formed integral with two transverse webs, the skirt being cut away at the sides. Three rings are fitted, the lowest being an oil scraper ring of special section which returns the surplus oil through drain holes in the skirt. The hollow gudgeon pins are of the fully floating



TWO VIEWS OF THE BRISTOL TITAN II: This engine is similar to the Neptune, but has five cylinders only.

which the mixture has to pass before reaching its respective induction pipe. Exhaust heating of the induction elbow, in which the heating effect may be varied, is also provided.

To return to the individual characteristics of the new Jupiter range, the Series VI F. H. (Standard Service engine) is rated at 420 b.h.p. at 1,700 normal r.p.m., the maximum speed being 1,870 r.p.m. This engine is designed to maintain the rated power to 4,000 ft. and is therefore throttled at ground level. The Series VI F. M. (General Purpose engine) is rated at 465 b.h.p. at a normal speed of 1,700 r.p.m., the maximum speed being 1,870 r.p.m., whilst the Series VI F.L. (Commercial) engine has a rated output of 445 b.h.p. at the same normal speed, the maximum speed also being as previously given. It should be noted that the above figures are not necessarily the full normal output, but the officially rated or guaranteed minimum, using standard Service fuel.

The cylinders and rocker gear are as previously described, the remainder of the engine, excepting the induction system, being similar in detail to that of the now widely-known Jupiter VI. The crankcase is machined from duralumin drop forgings, the centre portion being split on the plane containing the cylinders. It is machined all over and is a very fine piece of work. The two portions of the crankcase are bolted together by horizontal bolts fitted between the cylinder bases. The two-piece crankshaft comprises two forgings,

type, end location being by means of a circlip and retaining washer. The two four-lobed cam rings are driven at one-eighth crankshaft speed through an extremely neat and compact form of epicyclic gearing. The cams actuate the push rods through roller-type tappets, the tappet guides being of duralumin. The tappets of the four lower cylinders are provided with special oil-retaining baffles to prevent leakage. The pushrods are fitted at their lower ends with coil return springs.

The rear end of the crankshaft drives the magnetos which are arranged at an angle, one on either side of the rear cover, through bevel-gearing at 1½ crankshaft speed. The gear-type oil pumps are also driven by the rear end of the crankshaft extension.

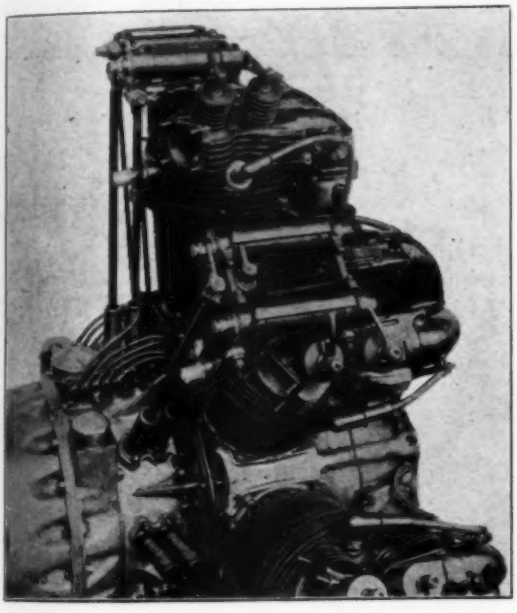
Lubrication is on the dry sump system, the crankcase being drained by a scavenge pump having approximately 30 per cent. greater capacity than the feed pump. A spring-loaded relief valve enables the feed pressure to be adjusted. Large filters are provided in both the feed and scavenge circuits and are so located that they may be cleaned without disturbing the oil piping. The return oil lead from the scavenge pump supplies warm oil to jacket the air intake of the carburettor.

The Bristol Triplex carburettor consists actually of two carburettors combined in one unit, these being operated by a common control and supplied by a single feed pipe.

spiral distributor, which, as previously stated, now has six baffles, is housed in an annular induction chamber which is bolted to the rear of the crankcase, from which the nine radial outlet pipes are taken. The carburettor air intake is jacketed by the warm oil from the scavenge pump on its way to the main oil tank, whilst the induction elbow through which the mixture passes from the carburettor to the bottom of the induction chamber, is exhaust heated. The pipes leading radially outwards to the cylinder heads are straight and are provided with expansion joints at one end. The top ends of these pipes are coupled to branched elbows which are bolted to the induction port facings of the cylinder head.

The two B.T.H. magnetos are spigot mounted to the rear cover and driven through a Vernier type serrated coupling, but to enable the magnetos to be removed without disturbing the setting of this coupling the driving element is provided with a two-jaw coupling which engages with a pack of flat steel springs, these forming a flexible drive.

The Series VII F, supercharged engine (also a Standard Service type), has a medium compression ratio and is designed to maintain its ground power up to 9,000 ft. The rated power at ground level is 500 b.h..p. at a normal speed of 1,775



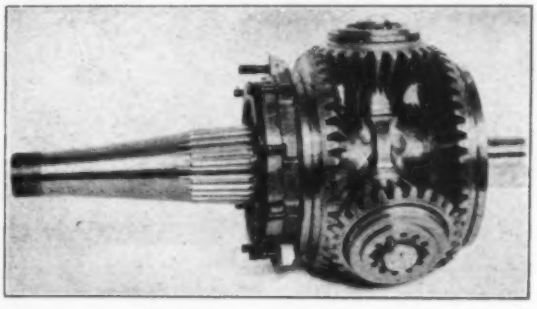
New cylinders of the Jupiter VIII F and other Bristol engines.

crankshaft r.p.m., the airscrew being directly driven. The rated power at 9,000 ft. is 480 b.h.p., also at a normal speed of 1,775 r.p.m.; the maximum speed is 1,950 r.p.m. Apart from the fitting of the supercharger unit at the rear of the engine in place of the usual induction spiral housing, the engine is generally similar to the Series VI F. The blower is of the high-speed centrifugal type fitted between the carburettor and the induction pipes. Slipping clutches, to protect the impeller from shocks and to ensure a constant torque, are interposed in the gear drive between the end of the crankshaft and the impeller, the latter being fitted coaxial with the crankshaft. The mixture is drawn from a Triplex carburettor and passes axially to the impeller whence it is discharged at high velocity through a ring of fixed diffuser vanes and passes thence into the annular induction chamber which takes the place of the usual induction spiral. From this chamber the mixture reaches the cylinders in the usual manner.

As previously stated the geared engines are available in three forms, each having a separate series number, according to the compression ratio, but are otherwise similar. The airscrew shaft is driven at half crankshaft speed in all cases. The Series VIII F (Standard Service engine) has a high compression ratio and is therefore ground throttled. The ground rating, 460 b.h.p. at 2,900 normal crankshaft r.p.m., is maintained to an altitude of 4,000 ft., the maximum crankshaft speed being 2,200 r.p.m. The General Purpose geared engine, the Series IX F, has a medium compression ratio and has a rated output of 515 b.h.p. at 2,000 crankshaft r.p.m., whilst the Commercial engine, having a low compression ratio, has a rated output of 490 b.h.p. at the same speed, the maximum speed in each case being 2,220 crankshaft r.p.m. Apart from the reduction gear, which is of the well-known Farman bevel-type, these engines are generally similar to the direct-drive or Series VI F type.

The reduction in airscrew speed is obtained by means of two similar bevel wheels arranged coaxially and facing each other, the rearmost being driven by the crankshaft and the foremost being held against rotation in the fore part of the crankcase cover, whilst in mesh with both bevel wheels are three bevel pinions mounted on radial spindles formed integral with the airscrew shaft. The latter is supported at its forward end by a bearing housed in the front cover, this bearing taking the airscrew thrust, and at its rear end by a spigot located in the forward end of the hollow crankshaft. This arrangement of gearing causes the pinion carrier to rotate at one-half the speed of the driving bevel wheel, independently of the relative sizes of the pinions and wheels. The fixed bevel is allowed a limited amount of movement about its spherical support, other than rotational movement, so that perfect alignment may be obtained under all conditions of load and shaft alignment. The end thrust of the bevel pinions is taken by ball bearings fitted at their outer ends of the spindles. The gear elements have been strengthened to withstand the increased torque developed by the F class engines.

The Neptune Series I engine is a seven-cylinder radial having a bore and stroke of 5·75 in. and 6·5 in. respectively.



The Reduction Gear employed in the geared types of Bristol engines.

The rated normal output is 270 b.h.p. at 1,700 r.p.m., whilst the maximum power is 315 b.h.p. at 1,870 r.p.m. As the compression ratio is 5 : 1 the engine is suitable for use in commercial and training aircraft. The cylinders are similar to those previously described with reference to the Jupiter F series, the valve arrangement and rocker gear being identical. The magnetos and all the auxiliary drives are located at the rear of the circular steel mounting plate, the two magnetos being driven by a cross shaft, one at each end. A Bristol Duplex oil-heated carburettor is fitted. The crankshaft and connecting rod arrangement and also the cam gear is similar to that of the Jupiter engine. The airscrew is directly driven by the forward extension of the crankshaft.

The Titan Series II is a five-cylindered version of the Neptune, the cylinders being interchangeable. The normal rated output is 205 b.h.p. at 1,700 r.p.m., the maximum power being 220 b.h.p. at 1,870 r.p.m. The arrangement of the auxiliary drives and the Duplex carburettor is also the same as on the Neptune. Either of these engines may be fitted with an inertia starter, provision for which is made at the rear of the auxiliary drive housing. Variable ignition is provided on both engines, the magneto controls being interconnected with the throttle control.

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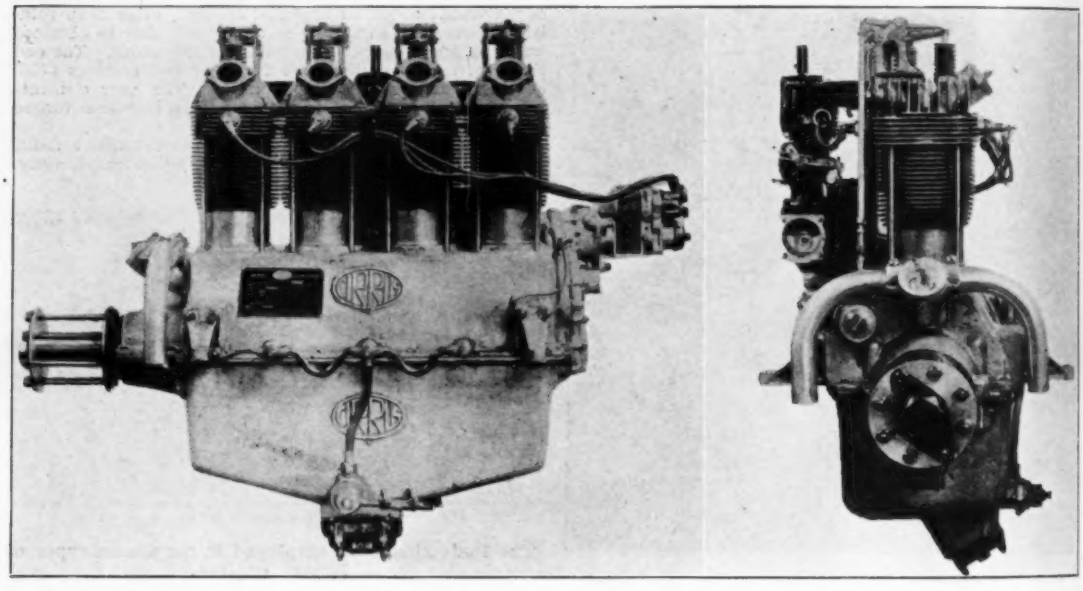
CIRRUS AERO ENGINES, LTD.

THE rapid development of the light aeroplane during recent years has to a large extent been made possible by the advent of suitable light engines. The most successful pioneer in this class of engine was the Cirrus, and it furthermore enjoyed the distinction of being the first British four-cylinder-in-line air-cooled aero engine to be successfully developed. The essentials of this engine are sturdy construction and simplicity of design, the reliability resulting from this combination making possible such epoch-making long-distance flights as London-Riga non-stop, and the 15¼ days 12,000-mile flight from England to Australia, both of which it will be remembered were accomplished by Bert Hinkler in a Cirrus-engined Avro Avian.

Cirrus Aero Engines, Ltd., are showing at Olympia three engines, two of which are of their latest Cirrus Hermes type, the other exhibit being one of the Cirrus Mark III type. One of the Hermes engines is shown cowled and gives an excellent impression of the clean fuselage lines which may be obtained with an air-cooled engine of this type.

The Cirrus Mark III has been produced to provide an alternative to the celebrated Cirrus Mark II and incorporates a number of modifications resulting in an improved performance and weight/power ratio, making the later engine particularly suitable for installation in light seaplanes. The general arrangement of the Cirrus engine is now fairly well known, but it may not be out of place to recall the main features of the design with special reference to those items which have been improved in the Mark III as compared with its predecessors.



THE CIRRUS III ENGINE : Side and front views.

The Mark III Cirrus has a normal output of 90 b.h.p. at 1,900 r.p.m. and a maximum output of 94 b.h.p. at 2,100 r.p.m., the airscrew being directly driven. These outputs are obtained with engines having a 5·1 : 1 compression ratio, but a higher compression ratio may be obtained if desired by the removal of the steel packing rings fitted between the bases of the cylinders and their bearing faces on the crankcase. The compression ratio so obtained is 5·4 : 1, the normal and maximum outputs thus being increased to 92·5 b.h.p. and 97 b.h.p. respectively at the crankshaft speeds previously stated. The petrol consumption is 0·6 pint per b.h.p. hour and the oil consumption 0·018 pint per b.h.p. hour.

The Mark III engine has a bore and stroke of 110 mm. and 130 mm. respectively. The cylinders are of composite construction, having cast-iron barrels which are spigoted into aluminium alloy heads, the cylinder assemblies each being secured to the crankcase by four long steel studs and nuts. The inlet and exhaust domes are cast integral with the cylinder heads, each terminating in flanges to which the induction and exhaust manifolds are bolted, the former being fitted on the starboard side, whilst the exhaust ports are on the port side. The two valves of each cylinder are arranged side by side on the transverse centre line of the cylinder, the stems being vertical. Two horizontal and diametrically opposed sparking plug sockets are provided in each combustion head. The brackets supporting the valve rocker pivots are bolted to platforms cast integral with the heads above the inlet domes.

The cast aluminium alloy crankcase is made in two portions, the top portion being stiffened by three transverse webs which carry the crankshaft intermediate bearings. The bottom portion of the crankcase forms an oil reservoir having a capacity of 12 pints. The oil base may be easily detached without disturbing the bearings, the caps of which are secured to the upper portion. The oil pump is fitted at the lowest part of the reservoir in a sump formed near the port side. A detachable cover is fitted over the timing gear housing, this being cast integral with the rear end of the crankcase. At the starboard side of the top portion a bracket is provided on which one of the magnetos is mounted, the other being spigot mounted to the rear face of the timing gear housing. Two forms of detachable bearer feet are available, one set giving a considerably lower mounting than the other.

The crankshaft is a one-piece forging and is carried in five bearings, the three intermediate bearings being of the white-metal lined bronze-bush type, whilst roller bearings are fitted at each end of the shaft. The airscrew thrust is taken by a ball thrust bearing housed in the forward extension of the crankcase casting. The airscrew hub is keyed to the tapered end of the shaft. The timing-gear driving pinion is fitted to the rear end of the shaft, close up against the roller bearing.

The " Y " alloy connecting rods are I-sectioned forgings, the big end being of the white-metal lined split-bush type. Each bearing cap is secured by two bolts. The cast aluminium pistons are each fitted with three rings and are secured to their respective rods by hollow gudgeon pins of the fully floating type.

Valve operation is by means of push-rod actuated rockers, the camshaft being fitted at the starboard side of the engine, where it is supported in the top half of the crankcase by three bronze plain bearings and one ball bearing, the latter

being fitted at the rear end. The camshaft is driven through a train of spur gears and is provided at its centre with a skew gear which drives the spindle of the oil pump. The tubular duralumin push rods are operated through tappets, adjustment being provided at the ball joints fitted at both ends of the rods. The rockers of each pair of valves are mounted one above the other on separate spindles, the exhaust above the inlet, the ends of the spindles being supported by light brackets. A grease gun nipple is fitted into the end of each hollow rocker spindle.

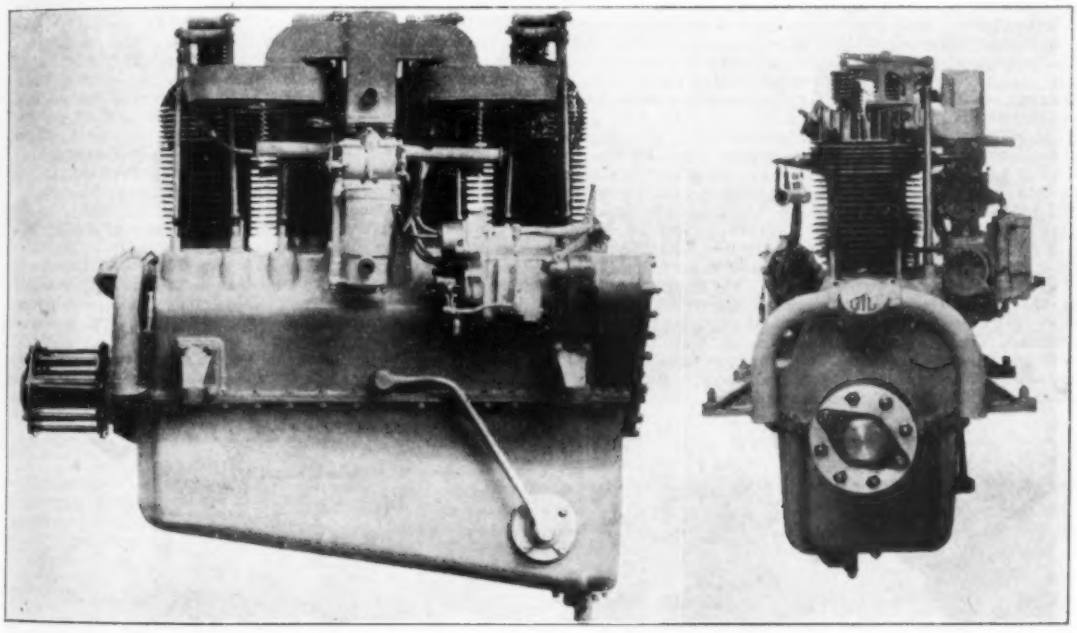
Lubrication is on the wet sump system, the gear-type pressure pump being located in a housing formed at the port side of the bottom of the sump. The oil pump spindle is fitted diagonally across the centre of the crankcase, in the transverse plane, the upper end of the spindle being driven by a skew gear at the centre of the camshaft. The pressure pipe leads to a filter situated in an accessible position just above the housing of the pump, at the port side of the crankcase. From the filter an external oil lead connects with a horizontal distributing pipe from which three branch leads direct oil to the crankshaft intermediate bearings. Smaller diameter leads are taken from both ends of the horizontal pipe to supply the bearings at the front end and the timing gears at the rear end of the crankcase. The oil passes from the journal bearings into the hollow crankshaft and so reaches the big-end bearings. The camshaft bearings, tappets, and cylinder walls are lubricated by splash from the big ends, the used oil draining back directly to the sump.

A Claudel-Hobson R.R.C.H. type carburettor is fitted at the starboard side, this being directly bolted to the steel manifold, which is of rectangular section and is exhaust jacketed at its centre.

Ignition is provided by two B.T.H. magnetos, each supplying four sparking plugs. The magnetos are situated one at each end of a shaft driven by the camshaft gear wheel, one magneto being fitted forward of the timing gear housing, whilst the other is spigot-mounted to the rear face, the distributors and contact breakers facing the front and rear on the front and rear magnetos respectively. The forward magneto is provided with an impulse starter which, the makers state, renders starting so easy by swinging the airscrew that it is unnecessary to fit other starting means unless the engine is to be installed in a seaplane, when a hand-turning gear can be supplied if desired.

The Cirrus Hermes has been produced to meet a demand for an engine of somewhat higher power than is provided by the Cirrus range. The new engine incorporates a number of modifications and refinements resulting from the experience gained with the earlier types. Reliability has remained the keynote of the design, the increased power being directly due to the larger capacity and not to other means which might have affected the reputation for reliability that the Cirrus has so long enjoyed. The bore and stroke are 114 mm. and 140 mm. respectively, the compression ratio remaining at 5·1 : 1. The normal output is 105 b.h.p. at 1,900 r.p.m. and the maximum output 115 b.h.p. at 2,100 r.p.m. The fuel consumption at cruising speed is 0·58 pint per b.h.p. hour and the oil consumption is from 1 to 1¼ pints per hour. As in the Cirrus engines, the airscrew is directly driven by the crankshaft.

The most important differences, compared with the Cirrus, are concerned with the arrangement of the auxiliary drives and in the design of the crankcase, the latter being shaped to provide a clean contour for the under cowling. The external appearance of the engine has been made remarkably clean ; there is, for instance, only one external oil pipe. The overall length has been reduced as compared with the Cirrus, by the re-arrangement of the magnetos, these being fitted in the Hermes one on each side of the crankcase, both being fitted forward of the timing gear housing, instead of having the tandem arrangement previously adopted. The crankshaft is carried in five white-metal lined plain bearings and steel connecting rods are fitted. The camshaft, tappets and push rods are now fitted on the port side. The dimensions between the bearer feet centres are the same as those of the Cirrus and thus provide for interchangeability.



THE CIRRUS HERMES ENGINE : Side and front views.

The cylinder construction is similar to that of the Cirrus, but the valve rocker arrangement has been slightly modified to suit the changed valve arrangement, the inlet manifold being on the port side of this engine. Furthermore, the valve rocker adjustment is now effected at the push-rod ends of the rockers.

The induction manifold is of entirely new design and provides for distribution from a central exhaust-jacketed portion to two separate manifolds each of which supplies one pair of cylinders. The timing gears are housed in a casing formed integral with the rear end of the top half of the crankcase, the whole being accessible on the removal of the triangular cover plate. Each magneto is driven through a Simms Vernier coupling and each is provided with an impulse starter. Variable ignition timing is provided, the controlling levers of the two magnetos being secured to a cross rod which is mounted in brackets bolted to the top of the timing gear housing. The ignition control is interconnected with the throttle control, so that the ignition is advanced as the throttle is opened.

The lubrication arrangements are similar to those of the Cirrus with the exception that the pump and filter positions

have been changed, the pump being fitted at the rear end of the oil base; also the external oil pipes are superseded by internal distribution arrangements. The oil pump is driven by a vertical spindle from the timing gears. An oil tray of special construction is fitted in the lower half of the crankcase to trap the reserve oil so that the engine is suitable for aerobatics. A gauge showing the quantity of oil in the base is fitted at the starboard side of the crankcase. Provision is made in the arrangement of the auxiliary drives for the inclusion of a hand-turning gear, gun-gear and fuel pump and revolution indicator drives. The latter is a standard fitment, the other items being supplied when ordered.

DE HAVILLAND AIRCRAFT CO., LTD.

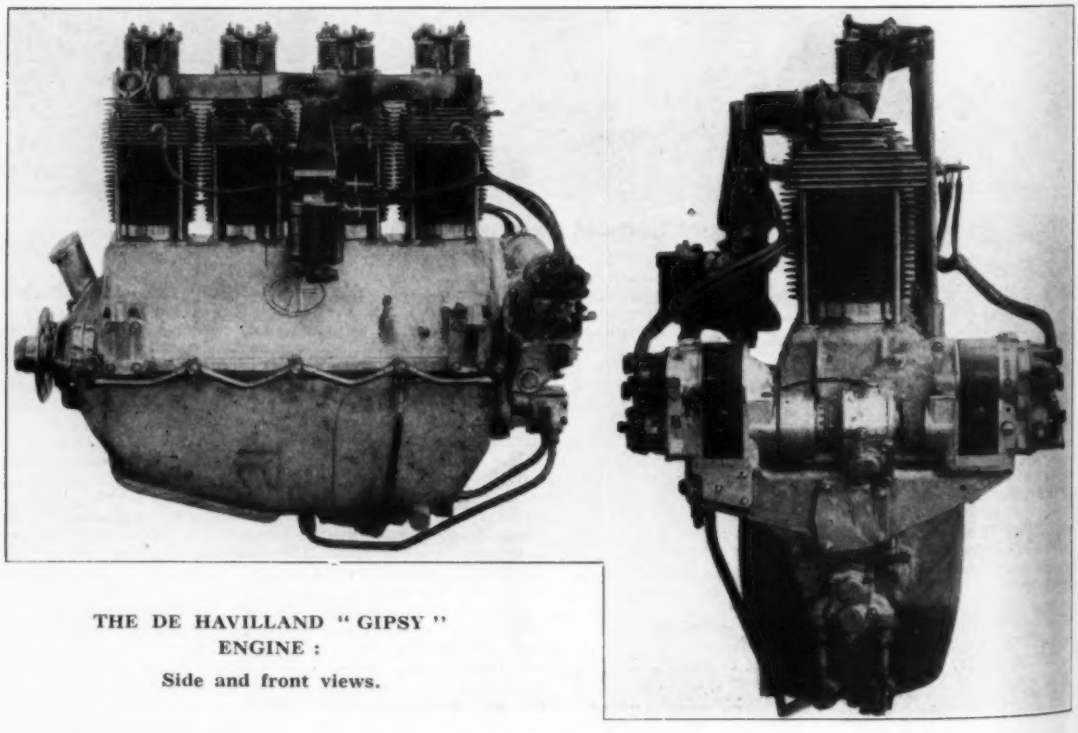
THE DE HAVILLAND AIRCRAFT CO. are showing at Olympia the Gipsy, a small engine which has done many big things during the past year, including the winning of the King's Cup Race last July. This engine is of the air-cooled four-cylinder-in-line type, having a bore and stroke of 114 mm. and 128 mm. respectively. It has a normal output of 90 b.h.p. at 1,900 r.p.m., and a maximum output of 100 b.h.p. and 2,100 r.p.m., the airscrew being directly driven. The fuel consumption is 0·59 pint per b.h.p. hour and the oil consumption 0·6 pint per hour at normal power and speed. In a reliability test which the firm is giving this engine under official observation it has already run for 475 hrs. without overhaul, having flown 41,800 miles, during which the fuel consumption has averaged 4·7 gallons per hour and the oil consumption only half-a-pint an hour.

The cylinders have cast-iron barrels which are spigoted into detachable aluminium heads, the joint being made gas-tight by a copper and asbestos washer. Each head is secured by four long steel studs and nuts which also secure the cylinder assembly to the crankcase, the barrels being deeply spigoted into the latter. The bearing surface in contact with the crankcase is provided by a circular flange formed on the cylinder barrel. The combustion head is of the "pent-house" type with the two vertical valves fitted side-by-side on the fore-and-aft centre line. The screwed-in bronze valve seats and the sparking plug sockets are expanded in position. The two sparking plug sockets are fitted horizontally into the sides of the heads but are not diametrically opposed. The ports and flanges for the attachment of the induction and exhaust pipes are both situated on the port side of the cylinder heads. Between the inlet and exhaust domes a bracket is cast integral, on which the rocker brackets are mounted.

The aluminium crankcase is in two portions and is very deep but of small width in cross-section. The top half is transversely webbed at each of the five crankshaft bearings. The lower half of the crankcase forms an oil reservoir having a capacity of two gallons. It may be removed without disturbing the bearings as these are secured to the upper half. A large filling neck is provided at the forward end of the crankcase. The four bearer feet are detachable, these being bolted to vertical facings provided at the sides of the top half. To the bottom of the sump is bolted a detachable circular cover plate on the inner side of which is fitted the cylindrical housing of the main oil filter. The forward sloping portion of the underside of the crankcase is finned longitudinally to provide an effective cooling area in contact with the reserve oil. The timing gear casing is bolted to the rear face of the upper half of the crankcase.

The crankshaft is a one-piece forging and is carried in five plain bearings, whilst a ball thrust bearing is fitted between a flange formed at the forward end and a small circular door bolted to the crankcase. The rear flange of the airscrew hub is mounted on a taper on the shaft to which it is keyed. The journals and crankpins are bored for lightness and to form oil spaces, the ends of the bores being closed by the usual coned cups.

The I-sectioned connecting rods are "Y" alloy forgings and are provided with white-metal lined bronze big end bushes, the big ends being of the split type; the caps are



THE DE HAVILLAND "GIPSY" ENGINE:
Side and front views.

secured by two bolts each. The slipper type aluminium alloy pistons have three rings each, two compression and one scraper. The gudgeon pin bosses are formed on two webs which extend downwards from the head, between which the connecting rods are secured by the hollow gudgeon pins, the skirts being cut away at either side. The load on the crown is thus transmitted direct to the gudgeon pin instead of via the skirt. The gudgeon pins are free to float in the small end of the rods and in the piston bosses, the bearing surfaces in each being unbushed. End location is provided by external circlips, washers being fitted between the circlips and the gudgeon pin bosses. The compression ratio is 5 : 1.

Valve operation is by means of a single camshaft and push rods, the camshaft being carried at the starboard side of the crankcase, where it is supported in five bearings, one between each pair of cams and one at each end. The camshaft is driven by a train of spur gears from a pinion on which a boss is formed, this being splined to fit into the internally splined end of the crankshaft. The camshaft driving wheel is provided with a Vernier adjustment to facilitate the timing of the valves. The intermediate gear wheel in the camshaft driving train is formed integral with a skew gear which drives a cross shaft, this in turn driving the two magnetos which are fitted one at each end of the shaft; they are bolted to platforms which are cast integral with the timing gear case. The oil pressure pump is also located in the lower part of this case, it being driven by a gear wheel which meshes with the crankshaft pinion. The driving spindles of the oil pump and of the intermediate timing wheel are mounted on ball bearings. Provision is made for the fitting of a hand turning gear, this also being fitted in the timing gear housing. A revolution indicator drive is also built into the casing.

The valve tappets are provided with curved contact faces at their lower ends, these working in slots in the guides. The tubular duralumin push rods have hardened steel ball and socket joints at each end. Adjustment is provided at the end of the rockers in contact with the valve stems. Each pair of rockers is mounted on a hollow steel spindle, one on each end, the spindle being carried by a steel bracket bolted to the head, one bracket to each cylinder. The rockers are bronze bushed and are provided with internal passages so that lubricant may reach both ends, the rocker spindles each being fitted with a Tecalemit grease nipple. The ball-ends of the rockers are protected from dust and water by metal caps. The valve stems are fitted with hardened steel thimbles and are each provided with two concentric helical valve springs.

Lubrication is on the wet sump principle, the oil being drawn by a gear type pump from the reservoir formed by the bottom half of the crankcase. From the delivery side of the pump an external pipe leads back into the bottom of the crankcase, the oil passing to the interior of the filter housing through a relief valve which discharges directly into the reservoir. From the filter housing, which is also provided with pressure relief valve, the oil is fed by an external lead to a horizontal external pipe situated on the port side of the engine. Branch leads from this pipe supply the crankshaft journal bearings and the skew gear driving the magneto cross shaft. From the main bearings the oil passes into the hollow crankshaft, and thence to the big-end bearings at a pressure of 30-40 lbs. per sq. in. The closed ends of the crank-pins and journals are provided with small leak holes from which the oil is thrown on to the cylinder walls, the camshaft bearings and the tappets. The oil drains back into the sump through a gauze filter tray situated below the joint between the two halves of the crankcase. The timing gears are lubricated by a jet which is supplied with oil by the branch lead from the horizontal distributing pipe, the jet directing oil on to the skew gears at the top of the casing, these distributing the oil over the remainder of the gears from which it drains back into the sump.

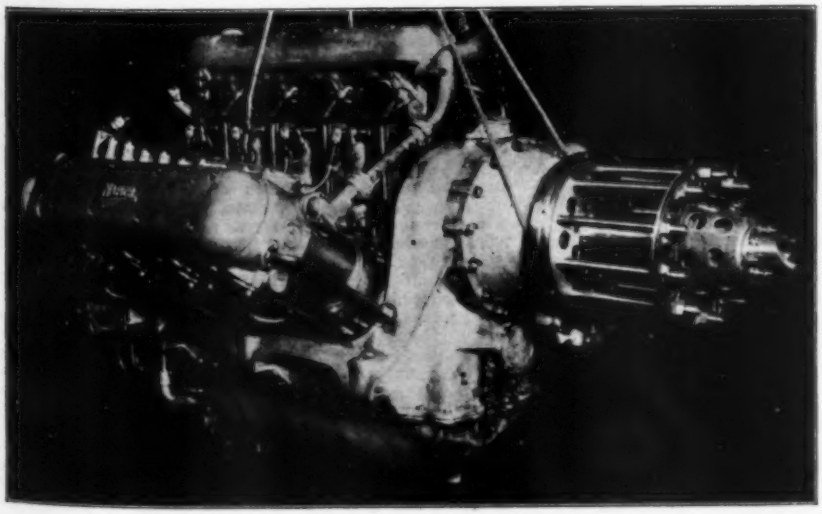
A type 48 R.B. Zenith carburettor is fitted at the port side of the engine, where it is directly attached to the steel induction manifold. The latter is of rectangular section throughout and is exhaust-jacketed immediately above the carburettor.

Dual ignition is provided by two B.T.H. magnetos, these being mounted across the rear of the engine with the distributors and contact breakers facing outwards. Each magneto is driven through a Simms flexible Vernier coupling. One magneto is fitted with an impulse starter to facilitate the starting of the engine when turning the airscrew by hand.

D. NAPIER & SON, LTD.

THE centre stand of the main hall at Olympia will indeed be a centre of attraction, for the Napier Co. are showing there, together with three other Lion engines, one of the Series VII B racing engines, which it will be remembered has established a record among record breakers in having attained the highest speeds yet achieved in international contests in the air, on the land, and on the sea. Two of the new standard production engines, the Series XI, are also being shown, whilst a further exhibit of absorbing interest to those who are fascinated by " watching the wheels go round " will be found in a working sectioned model of the older, Series V engine. We will deal firstly with the two more docile members of the Lion family.

The Series XI engines develop 540 b.h.p. at a normal

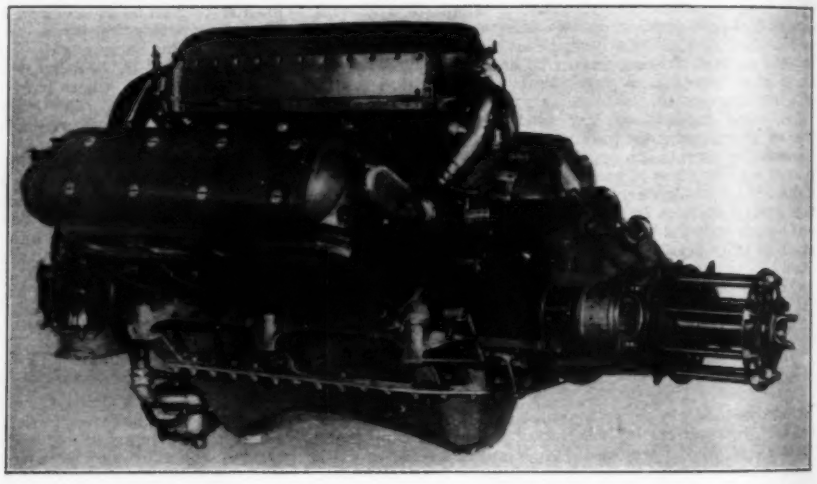


The Napier Lion XI is rated at 530 h.p.

crankshaft speed of 2,350 r.p.m., the maximum output being 575 b.h.p. at a crankshaft speed of 2,585 r.p.m. The fuel consumption is 0·5 lb. per b.h.p. hour using the standard Service mixture. The oil consumption is 0·0235 lb. per b.h.p. hour. The Series V engine develops 450 b.h.p. at a normal crankshaft speed of 2,000 r.p.m. and 502 b.h.p. at a maximum speed of 2,200 r.p.m.

The general arrangement of the standard Lion engine is now fairly common knowledge, but it may be of interest to recapitulate the more important features of the design, many of which although no longer new are still peculiar to the Lion. For instance, the Napier firm was the first to produce an engine of the broad arrow type, having more than three cylinders, the arrangement resulting in a twelve-cylinder engine in which the crankshaft is as stiff and free from torsional oscillation as that of a four-cylinder engine of one-third the power. Although this arrangement of the cylinders has been adopted by some Continental firms it still remains peculiar to the Lion among British engines.

In all three types of engines shown, the bore and stroke are 5¼ in. and 5½ in. respectively. The cylinders are machined from steel forgings, the combustion heads being formed integral. The water jackets are of sheet steel and are welded to flanges formed integral with the cylinder barrels around the top and towards the lower ends. The bottoms of the barrels are flanged and are bolted to the crankcase, into which they are spigoted. The individual



The Napier Lion Racing engine develops some 900 h.p. This year's Schneider Trophy engine will develop a good deal more.

cylinders are assembled to the crankcase in three rows of four, the outer banks being set at an angle of 60° to the centre bank. Each row of cylinders is secured to a common cast aluminium head which houses the valve gear and in which are cast the water, induction, and exhaust passages. This casting is secured to each group of heads by the four valve seats of each cylinder, the lower ends of the seats being flanged to fit into recesses machined on the inside of the combustion head, whilst the upper portions of the seat members are threaded and are screwed into the head casting. Each head casting also provides supports for the five twin-bearings of the two camshafts of each cylinder bank. Two sparking plug sockets are provided in each combustion head, arranged horizontally but not diametrically opposite each other.

The crankcase is of cast aluminium alloy and is made in two portions. On the top portion the three sets of cylinder facings are machined. The crankshaft bearing housings are also formed integral with the top half, whilst at the forward end the reduction gear casing is also cast integral. The lower portion of the crankcase is in the form of an easily detachable oil sump, the removal of which does not interfere with any bearing or other arrangements. The rear end of the crankcase is closed by a cover which carries the auxiliary drives, oil and water pumps, magnetos, carburettors and the hand-turning gear.

The four-throw crankshaft is supported by six bearings, namely, one roller-bearing between each throw and at each end, and one white-metal lined bronze bearing, the latter being located at the front end, forward of the reduction gear driving wheel. The roller-bearings are housed in transverse webs formed in the upper half of the crankcase. The bearing caps are of steel and are secured by studs and nuts to the upper housings. The reduction gear driving wheel is fitted on a taper and is keyed to the shaft between the plain bearing and the foremost roller bearing.

The crankshaft is in one piece and therefore necessitates an unusual method of fitting the three inter-throw journal bearings. The bores of the inner races are such that they allow the bearings to reach their positions by being threaded over the crankpins and webs, split packing bushes being then inserted to make up the full diameter of the shaft at the journals. The crankpins and journals are bored for lightness, the ends of the bores being closed to form oil spaces to which the oil is fed through the usual inclined oilways drilled through the crank webs.

The airscrew shaft reduction gear provides a ratio of 0·53 : 1 for the Series XI engines, and 0·66 : 1 for the Series V engines. The airscrew shaft is supported between roller bearings, one of which is carried by the reduction gear casing, whilst the other is housed in the front cover, the airscrew thrust being taken by a double thrust washer type ball bearing which is also carried in the cover, between the roller bearing and the gear wheel. The latter is in the form of a toothed ring which is bolted to a flange turned integral with the hollow airscrew shaft. The airscrew hub is splined to the shaft and is clamped between the usual coned faces.

The rear end of the crankshaft drives a short extension shaft through a dog coupling, this shaft providing the drive to the auxiliaries. Two integral bevel wheels arranged back-to-back are mounted on this shaft, the foremost bevel driving the inclined shafts through which the camshafts of the outer banks of cylinders are driven, whilst the second bevel drives the two horizontally mounted magnetos, these being arranged one on either side. The inclined shaft driving the port camshafts also drives the camshafts of the centre cylinder bank through a bevel which meshes with one fitted at the lower end of a vertical shaft. The foremost bevel of the auxiliary driving shaft also drives a downwardly extending vertical shaft, the lower end of which engages with the spindle of the water pump. This vertical shaft is provided with a worm which drives two worm wheels, one on either side, these being fitted to the driving shafts of the two scavenge pumps. The rear end of the auxiliary driving shaft is provided with dogs for the engagement of the hand-turning gear.

The hand-turning gear is of the type in which a worm wheel, fitted concentric with the axis of the crankshaft, is turned by a worm mounted on a transverse shaft, to the ends of which the starting handles are coupled. The engaging dog of the starting gear is carried on the end of a short splined shaft which passes through the splined hub of the worm wheel and is spring-loaded to remain in engagement until the engine fires, when it is forced out of engagement by the inclined faces of the dogs, the axial movement throwing the spring-loaded engaging arm through its dead centre position, and thus retaining the dogs out of engagement. As previously stated the whole of the auxiliary gears and the hand-turning gear are carried in a separate casing which forms the rear end cover of the crankcase.

The forged aluminium pistons are of the trunk type, and have flat tops. The compression ratios are 6 : 1 and 5·8 : 1 on the Series XI and Series V engines respectively. The pistons of the centre bank of cylinders are secured by hollow floating gudgeon pins to master connecting rods, whilst those of the outer banks are similarly attached to the auxiliary connecting rods, these being secured to their respective master big ends by hollow wrist pins. The end location of the gudgeon pins is by means of bronze buttons. The master rod big ends are of the split type, the bearing faces being white-metal lined. The wrist pins are each secured between lugs formed on the master ends by a dowel and taper, the taper end being pulled into its seat by a hexagon headed plug which closes the end of the pin. The small ends of all the rods are bronze-bushed, as also are the inner ends of the auxiliary rods.

The four symmetrically arranged valves of each cylinder are operated in pairs by two separate camshafts, one being carried above the row of inlet valves, whilst the other is mounted directly over the exhaust valves, the latter being situated on the outer sides of the outer cylinder banks and on the starboard side of the centre bank. Each camshaft is supported by five bronze-bushed plain bearings, the supports for which are cast integral with the valve gear casing. The inlet camshafts of the two outer banks are bevel driven by the inclined shafts fitted at the rear of their respective cylinder banks. The exhaust camshafts are driven by the inlet camshafts through equal spur gears fitted at the rear ends of the shafts. The camshafts of the vertical bank are similarly geared together, but the exhaust camshaft in this case is driven by the vertical shaft. The cams bear directly on tappet heads which are screwed into the ends of the hollow valve stems, to provide the necessary adjustment, and are locked after adjustment by a spring clip. The camshaft bearings are arranged one between each pair of inlet and exhaust valves and one at the extreme rear end of the shafts to support the driving gears and to take the thrust of the bevels.

The three camshaft driving shafts are divided, their adjacent ends being fitted into internally splined sleeve couplings to allow for expansion. These shafts are carried at each end in bronze-bushed plain bearings, the bushes having flanged outer ends to take the thrust of the bevels. The splined couplings are also supported by plain bearings housed in the tubular casings of the shafts. The vertical shaft is provided with a skew gear at its lower end, this forming the drive for the speed indicator.

Lubrication is on the dry sump system. Oil is fed under pressure to both ends of the crankshaft and thence through the shaft to the big end bearings where passages lead to the wrist pins and thence through the connecting rods to the gudgeon pins. The camshaft rearmost bearings are supplied by branches from the pressure pump formed by external piping. From these bearings the oil passes through the hollow inlet valve camshafts (exhaust in the case of the centre bank) to each of the bearings and the cam faces. Channels are provided between the twin bearings so that both are supplied from the one source. The lubrication of the cam faces is effected by the oil leakage from the ends of the bearings, this falling directly on to the tappets. The oil from the rear end of the valve gear housings drains back into the sump via the inclined and vertical shaft casings and the auxiliary drive casing, and from the front by external piping to a well formed at the forward end of the crankcase. The reduction gear is lubricated from the same source as that supplying the front end of the crankshaft, a passage leading from the plain bearing housing to a nozzle which directs the oil on to the gear teeth as they come into mesh. The airscrew shaft rear bearing is lubricated by the oil mist in the reduction gear housing, whilst a trough fitted near the top of the housing collects and directs oil to the front roller bearing and thrust bearing. The oil draining into the wells formed at both ends of the sump is returned by the two scavenge pumps to the separate oil tank. A strainer is inserted in the pipe line between the supply from the tank and the connection to the pressure pump.

The water pump has three outlets to which the pipes leading to the three-cylinder banks are connected. In each bank the water flow is divided, one flow being through the head casting, whilst the other is in parallel through the jackets surrounding the cylinder barrels. The latter are coupled together at the top and bottom by short flexible connections. The pipes leading from the cylinder banks are coupled to a large common outlet, this being bolted to the front end of the vertical bank, and from which the lead to the radiator is taken. There are two return pipes to the pump, one from the radiator and one from the carburettor jackets.

Ignition is provided by two 12-cylinder B.T.H. magnetos, these being mounted transversely at the rear of the engine with their distributors facing outwards. A Vernier type coupling and flexible form of drive is fitted between the spindle of each magneto and the driving bevel.

A triple Napier Claudel-Hobson type carburettor is mounted on a bracket at the rear of the Series XI engine and supplies the three induction manifolds. The latter are formed by aluminium castings bolted to the inner sides of the outer banks of cylinders and to the port side of the centre bank. The manifolds are of trough section and are water-jacketed. The carburettor throats are also water-jacketed. In the Series V engine one duplex type and one single carburettor are fitted at the front end of the crankcase.

The Series VII B racing engine is similar in general design to its forerunners but is modified in several respects, with the object not only of increasing the power output but also of reducing the weight and overall dimensions, especially the height of the cylinder banks, thereby enabling the cross-sectional area of the fuselage of the air craft in which it is to be installed to be reduced to the minimum. The bore and stroke remain the same but the connecting rods have been shortened to reduce the length of the cyclinders, and the compression ratio has been raised to 10 : 1. With this abnormally high ratio it is, of course, only possible to run on specially doped fuel, the consumption of which is 0·46 pint per b.h.p. hour. It is stated by the makers that this engine has the highest thermal efficiency of any heat engine yet built. The maximum power output is 875 b.h.p. at 3,300 r.p.m., the normal output being 812 b.h.p. at 3,300 r.p.m. As the weight of the engine is only 930 lbs., the weight power ratio at maximum power is only just over 1 lb. per h.p.

Among the other items which have been modified or redesigned may be mentioned the reduction gear and housing and the magneto drive. The reduction gear gives an airscrew shaft speed ratio of 0·767 : 1 and is so arranged that the shaft is co-axial with the crankshaft, the reduction gear being of the layshaft type. The two Watford 12-cylinder magnetos are in this engine fitted at the forward end, where they are mounted on brackets cast integral with the gear housing. The magnetos are arranged with their spindles nearly parallel to the airscrew shaft, the distributors facing rearwards. The cam gear housings and covers have also been modified in shape and are formed with varying cross-sections from front to rear to suit the contour of the engine cowling.

THE POBJOY ENGINE

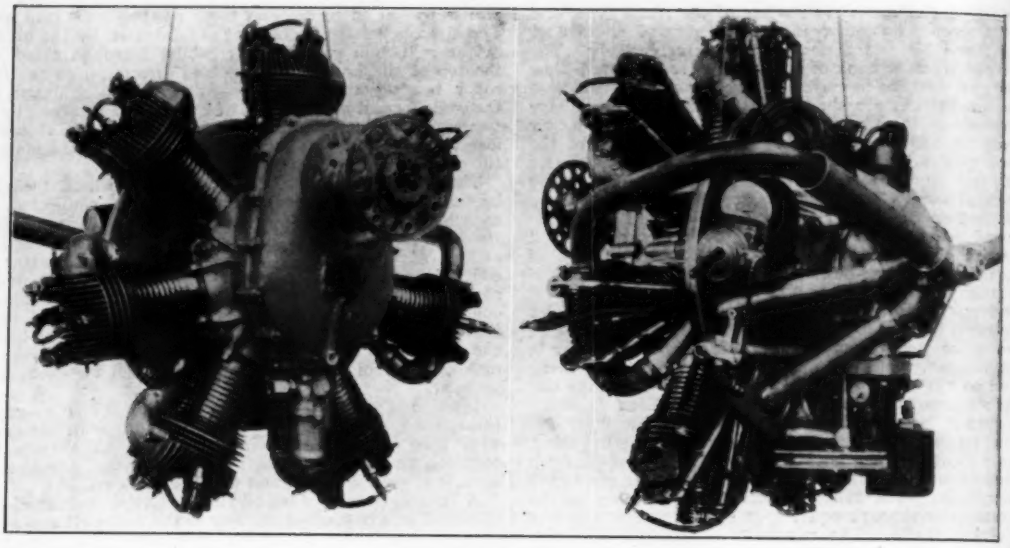
ALTHOUGH the Pobjoy engine will be seen by many for the first time at Olympia, it is now some time since it was originally designed and built. It made its debut in the light 'plane competition of 1926 at Lympne, when it was installed in the Cranwell C.L.A.4 machine, and last year passed the Air Ministry type test for civil engines. The engine will also be exhibited on the stand of George Parnall and Co.

The engine is of the geared seven-cylinder static radial type. The airscrew shaft is driven through a double-helical reduction gear providing a ratio of 0·255 : 1. The bore and stroke are 72 mm. and 87 mm. respectively, giving a total capacity of 2½ litres. The compression ratio is 5·7 : 1.

The engine is of exceptionally small size (25-in. overall diameter) for its power, the normal output being 64 b.h.p. at 3,000 crankshaft r.p.m., whilst the maximum power is 67·5 b.h.p. at 3,300 crankshaft r.p.m. The fuel consumption is 0·57 pint per b.h.p. hour and the oil consumption 0·25 pint per b.h.p. hour.

The steel cylinder barrels are screwed into cast duralumin heads; two inclined valves are provided in each head. The valve rocker pivots are carried in ball bearings mounted in supports formed integral with the heads. The makers state that the cylinder heads and valves remain so cool during running that the engine may be safely cowled in.

The crankcase is in four portions, the centre or body portion being divided on the plane containing the axes of



THE POBJOY AERO ENGINE : Three-quarter front and three-quarter rear views. Note the arrangement of the reduction gear.

the cylinders. The latter are secured to the crankcase by flanges formed on the bottom of their barrels by four bolts each. The front half of the body carries the rear bearings for the airscrew shaft and is provided with an opening in the bottom to which the sump and oil pump unit is bolted. The rear half of the centre portion houses the cam ring and is provided with sockets for the push rod tappet bearings. The crankshaft main bearings are fitted one in each half of the centre portion. The front portion of the crankcase is formed by a cover which houses the reduction gear and carries the forward bearing of the airscrew shaft and supports the front end of the crankshaft, in a plain bearing. The rear of the crankcase is closed by a cover which houses the cam gear, and carries the magnetos and the induction manifold, to which the carburettor is directly attached. The induction manifold is in the form of a spider to which the seven induction pipes are coupled.

The crankshaft is of the single throw, two-piece type, carried between two main roller bearings, a plain bearing being fitted at the front end, this working in the front cover, whilst the rear end of the crankshaft is supported by a ball bearing. The connecting rods are of the type in which six articulated rods are attached to a master rod by floating wrist pins. The master rod big end is made integral, the bearing being formed by a floating bronze bush. The crankpin and big end ring bearing surfaces are hardened.

The aluminium slipper type pistons are secured to the rods by floating gudgeon pins. Each piston is provided with two compression rings.

The reduction gear comprises two double helical spur gears, an unusual feature of the engine being that a small fly-wheel is secured to the front of the crankshaft gear wheel. The fly-wheel serves a double purpose, its primary object being to steady the crankshaft. Secondly, the fly-wheel is made hollow and the oil supplied to the end of the crankshaft through the front cover is fed through the interior of the wheel which thus acts as a centrifugal separator. At the high crankshaft speeds of this engine any particles of matter which are too fine to be filtered by the gauze strainers in the sump are effectively removed by the separator, the capacity of which is such that it need not be cleaned more frequently than once every 100 hours. The front of the wheel is closed by a screwed cover which is easily accessible on the removal of the front cover of the crankcase.

A detachable unit comprising the oil sump, scavenge and pressure pumps and their filters is bolted to the bottom of the front half of the crankcase body. The two filters may be removed without detaching the oil leads. The supply pump forces oil through passages in the front cover to the plain bearing of the crankshaft at a normal pressure of 35 lbs. per sq. in., the oil passing thence to the crankpin and auxiliary drives through the usual oil ways.

The single Zenith 36 A.K.B. type carburettor supplies mixture to the centre of the cast aluminium distribution spider and thence through the induction pipes to the sides of the cylinder heads, where they are attached to elbows which are bolted to flanges provided on the head castings. An exhaust-heated hot spot is provided at the centre of the spider.

The dual ignition arrangement is unusual in that two single-point B.T.H. magnetos each supply one plug per cylinder through a vertical distributor driven by the inner end of each magneto spindle, the seven leads to the plugs being taken from these distributors. With this arrangement the magneto armatures are geared to run at a higher speed than usual, thereby ensuring easy starting. It is in fact found unnecessary to fit any priming device. Variable timing is provided, the control being coupled to the throttle lever to give an automatic spark advance as the throttle opening is increased.

A vertical mounting plate formed by a Staybrite steel pressing is provided with four bosses for attachment to the ends of the fuselage members. The plate is bolted to the flange formed at the joint between the near cover and the centre portion of the crankcase. The induction pipes and high-tension leads are taken through apertures provided in the plate to accommodate these items. A boss is fitted at the extreme rear of the induction manifold for attachment to the fireproof bulkhead to act as a steady, if desired.

THE REDRUP LEVER ENGINE SYNDICATE

ONE of the novelties among the engines at the Show, if not indeed *the* novelty, is provided by the Redrup axial engine. This is an air-cooled, seven-cylinder engine in which the axes of the cylinders are horizontal and parallel to each other and the crankshaft. The cylinders are therefore grouped around the crankshaft, as the cartridge chambers of a revolver, with their heads at the front end, the pistons reciprocating in a fore-and-aft sense and driving the crankshaft through a peculiar form of " wobble " gear. The novelty of this engine, however, does not lie in the arrangement of its cylinders, for the internal-combustion engineering world has in the past been startled at fairly regular intervals by aero and other engines of this type, which their designers have termed " revolutionary," but as each has faded away in

turn, it may be concluded that the revolutions have failed to materialise. The most important feature of the Redrup engine is the form of "wobble" gear employed, this being designed to overcome the high loads and/or rubbing velocities which have been the chief causes of failure in previous engines of the axial type.

The obvious advantage that a successful axial engine would have over all other existing types would be that of small frontal area due to its extreme compactness, the projected area of a 100 h.p. axial engine being approximately one quarter that of a radial engine of sim lar output.

The Redrup engine has a normal output of 85 b.h.p. at 2,000 r.p.m., the maximum output being 100 b.h.p. at 2,200 r.p.m., the airscrew being directly driven. It has a bore and stroke of $3\frac{7}{10}$ in. and $4\frac{1}{2}$ in. respectively, and a compression ratio of 5 : 1. The dry weight is only slightly in excess of 200 lb., an unusually low weight/power ratio for the size of engine.

The cylinder block is formed by an annular shaped aluminium casting in which the seven steel cylinder liners are cast *in situ*, the ends of the liners projecting rearwards from the casting to form spigots which fit into sockets provided in the front portion of the crankcase. The heads are cast integral with the block, the whole unit being finned longitudinally. The combustion space is of unusual form, as it is long and narrow, projecting forward, in axial section. The two valves are located one behind the other, the exhaust valve being foremost, with their seatings located on the inner face of the combustion head. The two sparking plugs are located in the narrow side walls, opposite each other and the inlet valve. The bronze valve seats and sparking plug adapters are also cast *in situ*. Removable cover plates are provided on the outer sides of the heads to give access to the valves, the covers being fitted so that the internal pressure tends to tighten the joints. The centre of the cylinder unit is closed by the timing gear housing, this portion being secured to the main casting by seven long bolts.

The crankcase is in two portions, the foremost portion carrying the sockets into which the cylinder barrels are fitted, and the housing for the main front crankshaft bearing. The rear portion provides the support for the rear end of the crankshaft and has bolted at its centre a smaller casting which houses the auxiliary drive gears. The crank chamber is finned longitudinally to increase the rigidity and to provide a greater cooling surface. The two magnetos are spigot-mounted to the rear of the auxiliary drive casing, one at either side of the crankshaft, with their spindles parallel to each other, the distributors facing rearwards.

The reciprocating motion of the pistons is converted into rotary motion by coupling each to the end of a radial arm of a seven-armed star member. The arms are formed integral with a hub which is freely mounted on the crankpin of a Z-shaped crankshaft, *i.e.*, a single-throw crankshaft in which the crank webs are set at 180° apart, the axis of the crank pin intersecting the axis of the crankshaft at an angle of 20°. The star member is prevented from rotating by a forked member, the hub being provided with bosses at either side which bear in trunnions provided in the jaws of the fork. The vertical stem of the forked member is secured at the bottom of the crankcase by a spherical bush, forming a ball-and-socket joint, which allows the fork to twist about its vertical axis. It will be apparent that if the crankshaft is rotated through 180° the inclination of the crankpin will change from, say, an angle from the rear crank web downwards to a corresponding angle upwards, the plane containing the arms of the star member, which it will be remembered is free to twist laterally (although held by the torque reaction member against rotation about the crankpin) will have moved from its maximum inclination in one direction to a maximum inclination in the other, the travel of the outer end of each radial arm being equal to the stroke. As the action is reversible a thrust on the pistons will cause the crankshaft to rotate.

The pistons are connected to the star member by short connecting rods which are universally jointed at each end to allow for the very slight angular movements of the rods which occur as the pistons reciprocate. The star member is an aluminium casting and is divided axially to allow it to be assembled to the crankpin. Each arm is approximately triangular in side elevation, the apex being shaped to form jaws into which the transverse members of the universal joints securing the connecting rods are fitted. The hub is supported by a roller bearing at each end of the crankpin, the end thrust being taken by a deep-groove ball-bearing fitted at the centre of the crankpin.

The crankshaft is supported by a roller bearing near the rear crank web and by a deep groove ball bearing near the front crank web, this bearing also taking the airscrew thrust. It is of interest to note that in an engine of this type the end load on the crankshaft due to the axial component of the turning effort, acts in opposition to the airscrew thrust. The long forward extension of the crankshaft is supported by a smaller roller bearing at the rear of the timing gear housing and by a plain bearing in the front cover, this being provided with an oil retaining gland. Bronze balance weights are fitted to the crankshaft, opposite each crank web.

The cast aluminium alloy pistons are unusually short in the skirt as they have practically no side thrust to withstand; each is fitted with two compression rings and one scraper ring. The valves are actuated by tappets which are directly lifted by means of epicyclically driven cam drums, the latter being formed by sleeves which are mounted on eccentrics keyed to the crankshaft, the forward end of the sleeves being toothed to engage with an internally toothed ring which is fixed in the timing gear housing. The cam sleeves have a very low peripheral speed, and it has been found unnecessary to interpose a roller or similar member between the contact face of the tappets, as the travel of the contacting surface is almost entirely radial. Each valve stem is surrounded by two concentric steel wire coil springs, these being totally enclosed by cylindrical covers.

The rear end of the crankshaft is splined internally, the splined end of a short extension shaft being fitted therein. This shaft carries a gear wheel which meshes with those driving the magnetos, whilst behind this wheel is fitted a pinion driving the gear wheel of the oil pump spindle. The end of the auxiliary drive shaft is supported in a plain bearing housed in the gear cover.

The pressure oil pump supplies oil through a duct in the auxiliary gear housing to the rear end of the hollow crankshaft. A short pipe fitted into the outer end of the front crank web is curved forward to provide a jet of oil which sprays the cylinder walls and pistons as the shaft rotates. The timing gears are lubricated by oil supplied from the interior of the crankshaft. A sump formed at the bottom of the crankcase is drained by the scavenge pump through an external pipe.

Ignition is provided by two B.T.H. high tension magnetos, one of which is provided with an impulse starter. A Claudel-Hobson A.V.48 C carburettor is fitted below the cylinder group and supplies the mixture through a vertical duct in the casting to an annular chamber surrounding the crankshaft, from which the induction passages lead radially outwards to the inlet ports. Adjacent to the inlet ports are the exhaust passages, these leading to a common exhaust collector ring which surrounds the front of the engine.

ROLLS-ROYCE, LTD.

FEW, if any, aero-engines throughout the world have established as long-standing a reputation for reliability and service as those built by the Rolls-Royce Co. This firm is showing five examples of their new 12-cylinder V-type water-cooled engines, two of which are of special interest, having been recently released from the secret list. One of these is the new HX type engine, whilst the other is a supercharged version of the now familiar F type. The other three exhibits are also F-type engines. One is a very interesting sectioned model of the supercharged type; another is the standard non-supercharged F type, whilst the remaining exhibit, a mounted and partly-cowled engine, demonstrates very clearly why water-cooled engines are installed in aircraft in which pure speed is the primary object of the design. The robust yet light construction of the Hawker mounting, the generally neat appearance of the installation, and the fine workmanship of the cowling should be noted.

All the normally-aspirated F-type engines are similar externally and in all mechanical details excepting the airscrew shaft reduction gears. Two ratios are available, namely, 0·632 : 1 and 0·552 : 1, the engines so fitted being designated the F.XI and F.XII types respectively. Each type is further divided into two classes, A and B, according to compression ratios, the A class having a ratio of 6 : 1 and the B class 7 : 1.

The A class engines develop 430 b.h.p. at ground level

at a normal speed of 2,250 crankshaft r.p.m. The B class high-compression engines are designed to maintain their ground-level power—480 b.h.p. at 2,250 crankshaft r.p.m.—by increasing the throttle opening until an altitude of 3,000 ft. is reached; on full throttle at ground level the output is 570 b.h.p. at 2,475 crankshaft r.p.m. The fuel consumption of the A class engines is 0·49 pint per b.h.p.-hour, and that of the B class 0·46 pint per b.h.p.-hour at normal r.p.m. and throttle opening in each case. For both types the oil consumption is 5 pints per hour at normal output and speed.

Although the F type engine has been previously described in FLIGHT a *résumé* of the important features of this engine may not be out of place in this issue, especially as the new engines are very similar, excluding the fitting of the supercharger unit and the location of the carburettors. The cylinders are arranged in two banks of six cylinders each at 60°, the bore and stroke being 5 in. and 5½ in. respectively.

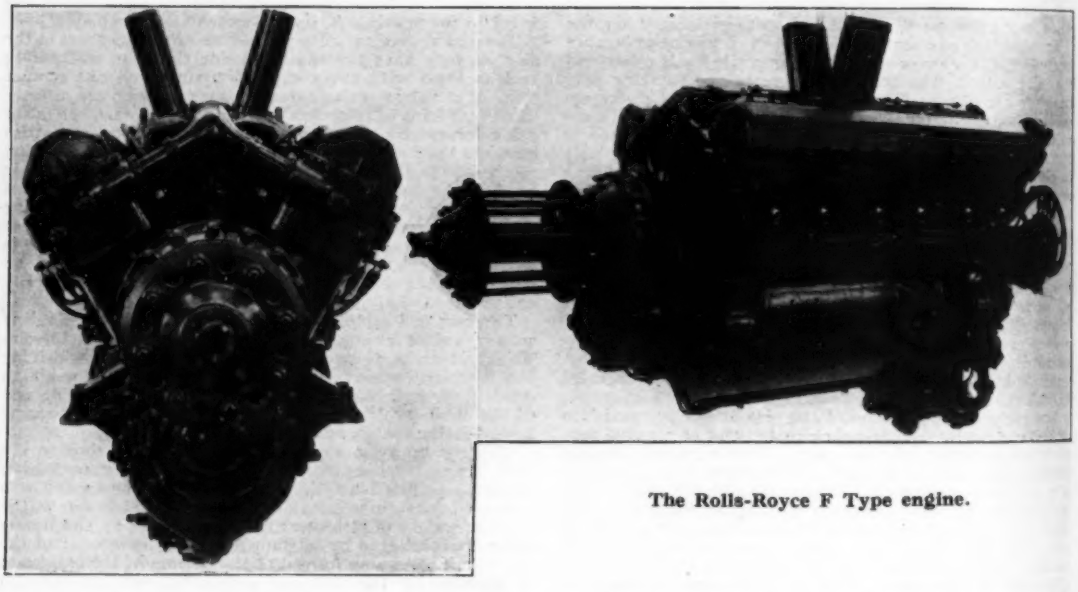
The most noticeable departure from previous Rolls-Royce practice that is to be found from an external examination of these engines is with regard to the cylinder design. In place of the separate cylinder construction formerly employed, the cylinders of the F and H type engines are arranged in two aluminium monoblock castings of six cylinders each. The upper ends of the carbon-steel cylinder barrels are secured by special gas-tight joints in the blocks, whilst their lower ends pass out through sliding water-tight joints and are spigoted into the crankcase, flanges forming the bearing faces in contact with the crankcase. Each cylinder barrel is strengthened by a number of circumferential ribs. Each cylinder block assembly is secured to the crankcase by a number of long bolts, these extending downwards from the heads. The cylinder heads, together with the admission and exhaust passages, are cast integral with the blocks, the sides of which form the water jackets; no transverse walls are formed in the blocks between the cylinders. The top of the combustion space is flat and each is provided with four removable valve seats and four cast-iron valve guides; the valves have their stems parallel to the cylinder axes. The valve gear and the overhead camshaft are totally enclosed by aluminium covers which are bolted to the tops of the cylinder blocks, the whole forming a very compact and neat assembly.

The crankcase is in two portions, the seven crankshaft bearings being so arranged that the lower portion of the case may be removed without disturbing the bearings. This is made possible without sacrificing bearing rigidity, by employing an unusual method of supporting the bearing caps. The latter are bolted as usual to the upper portion of the crankcase, but in addition each is secured by two long transverse bolts which pass through the caps and through the lower parts of the transverse stiffening webs which are cast integral with the top half of the crankcase at each bearing.

The crankshaft is a nickel-chrome steel forging, the crankpins and seven journals being bored out for lightness, while the crank webs are drilled to provide oilways communicating with the spaces so formed. The ends of the bores are closed by pairs of coned caps, each pair being tightly drawn into the ends of the bores by a single bolt. The split mild-steel bearing shells are white-metal lined and are fitted into recesses formed in the upper portion of the crankcase casting, the caps of each being secured by four vertical and two transverse bolts in the manner previously described.

The pistons are of Y alloy and are secured to their respective connecting rods by floating gudgeon pins, the end location of the pins being provided by spring rings inserted in the ends of the gudgeon pin bosses. The pistons fitted in the B class engines are made with a slightly greater length above the bosses to provide the increased compression ratio, but are otherwise similar to those of the lower compression engines. Each piston is fitted with three compression rings and one grooved oil-scraper ring, the latter being fitted at the bottom of the skirt.

The forged H-section connecting rods are of heat-treated nickel steel. The big-end arrangement is of the type in which one rod bears directly on the crankpin, and is forked to accommodate the big-end of the other rod, the bearing for which is formed on the outer face of the big-end of the forked rod, between the forks. The big-ends in contact with the crankpins are in the form of split blocks which are lined with white-metal on their internal and external bearing faces. The big-end bearings of the plain rods are of the split unbushed type. Floating bushes of phosphor-bronze are fitted in the small ends of the plain and forked rods.



The Rolls-Royce F Type engine.

The airscrew shaft reduction gear is of the straight spur type, the gear wheels being of air-hardening steel with ground teeth. To the flanged forward end of the crankshaft is bolted an internally-toothed ring into which are engaged teeth cut at the rear end of the reduction gear pinion driving shaft, the forward end of this short shaft being splined to engage the splined front boss of the hollow pinion. The bosses at front and rear of the pinions provide the bearing surfaces for the roller bearings which support it in the reduction gear housing, the end location of the pinion being fixed by a small ball-bearing fitted within the bore of the front boss. It will be understood that the pinion bosses form in effect a hollow shaft surrounding the pinion driving shaft, the drive being transmitted through the splined forward end of the latter. This arrangement entirely frees the crankshaft from any end loads which might otherwise be imposed on it if the pinion were positively coupled to it.

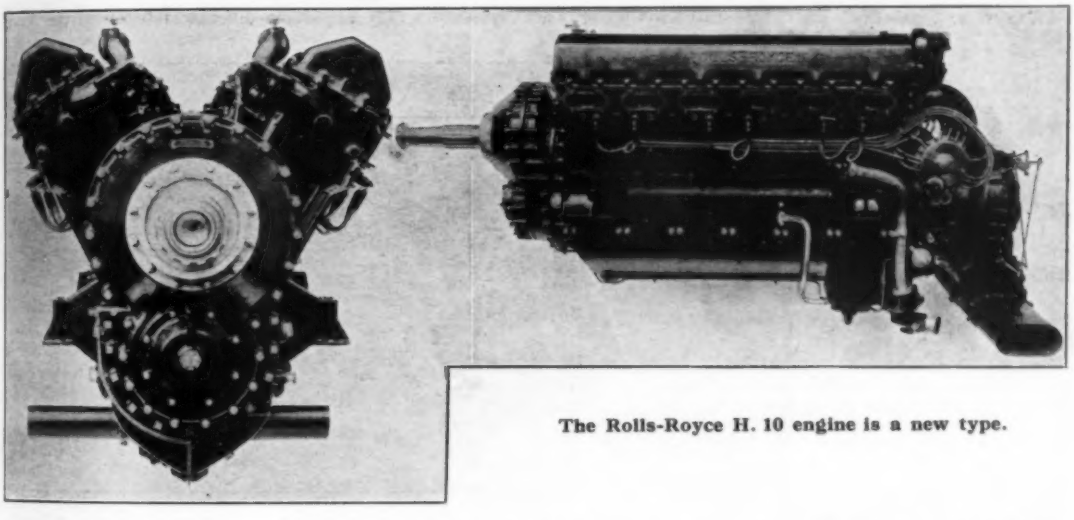
The airscrew shaft gear wheel is formed by a toothed

ring which is bolted to a flange formed integral with the rear end of the hollow shaft. The latter is carried between two roller bearings, a double thrust ball-bearing being located between the foremost roller bearing and the gear wheel. The thrust bearing serves to locate the axial position of the airscrew shaft in addition to taking the thrust of the airscrew. The reduction gear casing is formed in two portions, the joint being vertical and in alignment with the centre line of the gear wheels. The rear portion of the casing is bolted directly to the front of the crankcase. The nickel steel airscrew hub is splined to the shaft in the usual manner, and is located between the conical faces provided by a tapered collar fitted at the rear and a coned nut at the forward end.

All the auxiliary drives, namely, the camshaft, magneto, oil, fuel and water-pump driving shafts, are located at the rear of the engine, and great care has been taken both to damp the torsional vibrations of the crankshaft and to prevent any such vibrations or irregularities in torque and angular velocity from being transmitted to the driven shafts. The camshafts are bevel-driven by two inclined shafts which are in turn bevel-driven at their lower ends by a short vertical shaft, this being driven by a bevel wheel which is arranged co-axially with the rearmost crankshaft bearing. This bevel wheel is driven by a torsionally flexible shaft through a friction-ring type of damper fitted at its rear end. The fuel pump. The centrifugal water pump is fitted vertically below the lower auxiliary shaft, the impeller being driven by a spindle which is fitted within the hollow driving shaft.

The housing for the whole of the auxiliary drive arrangement of the non-supercharged engine is formed by a single casting forming a detachable unit which is bolted to the rear of the crankcase, excluding the cover previously mentioned. The water pump is bolted directly to the bottom of this housing. The hand-turning gear is also housed in the auxiliary drive casing.

The turning gear consists of a worm and wheel which drives the sleeve shaft on which the main auxiliary gear driving bevel is mounted. The worm is splined to the centre of a transverse shaft, the ends of which project from the casing to enable a handle to be fitted at either side of the engine. The worm wheel drives the bevel, and hence the crankshaft, through a multiple-disc type of clutch. The purpose of the clutch is to allow slip to occur in the event of a back fire, the worm being irreversible and providing a reduction of 13 : 1. When the crankshaft rotates in the correct direction, as the engine fires, the worm is carried out of engagement with the worm wheel, and is retained in this position by a helical spring which is compressed when the worm is initially moved into mesh by sliding it along the splines prior to starting, a striking gear being provided for this purpose.



The Rolls-Royce H. 10 engine is a new type.

amount of "spring" provided by this form of flexible drive is positively limited by a sleeve shaft which is fitted over the torsional member, the drive being positive after the desired amount of flexure of the shaft has taken place. The rear end of the torsion shaft and driving sleeve is supported by a ball-bearing, the outer race of which is mounted in the detachable end cover of the crankcase, a separate door being fitted to give access to the torsional vibration damper, except in the case of the supercharged engines. The forward ends of the torsion shaft and driving sleeve are both splined to engage with the internal splining of the rear end of the crankshaft.

The short vertical shaft is mounted in ball bearings at each end. Close to the lower bearing a skew gear wheel is splined to the shaft, this meshing with a similar wheel fitted at the centre of a transverse shaft, the ends of which drive the two magnetos. The two inclined driving shafts are also supported by ball bearings at each end fitted on the inner sides of the bevel pinions, as close as possible to the latter. Each inclined shaft is in two portions, serrated couplings being fitted near their lower ends to allow for the expansion of the cylinder blocks. Both shafts are totally enclosed in tubular casings.

A second vertical shaft is fitted below that transmitting the drive to the camshafts, this shaft extending downwards to drive the water, oil, and fuel pumps. This shaft is also supported between ball bearings fitted at each end. At the lower end, a spur gear wheel is fitted which drives, through an idler, the gear wheel fitted at the top of the vertical spindle driving the gear-type oil pressure and scavenge pumps. Near the oil pump driving wheel a skew gear is fitted to the main vertical shaft, this meshing with a similar wheel which drives a transverse shaft, which in turn drives a gear-type

The camshafts are of case-hardening nickel-steel, the bearing surfaces and the cam faces being hardened and ground; separate cams are provided for each valve, these being operated by separate rockers. Each group of four cams is supported between two plain bearings, a ball thrust washer being fitted at the rear end of each shaft to take the thrust of the bevel driving wheel. Each camshaft bearing is split and bushed. Brackets are provided at each side of the bearing supports, in which the two rocker carrying shafts are mounted. The rockers are of the straight lever type, one end being fitted with an adjustable tappet-screw, whilst at the other end is formed an integral bearing sleeve. The inner ends of the rocker bearings are separated by tubular distance pieces fitted over the rocker support shafts, between each pair of rockers. The two inlet valves of each cylinder are fitted on the inner side, and are operated by the rockers carried by the outer support shafts, the exhaust valves being operated by the rockers carried by the inner support shafts. The cams make contact with a hardened bearing pad formed integral with the top surface of each rocker, near its free end. The adjustable tappet screws have rounded ends, and bear directly on the valve stems. Each of the rocker pivots are bushed, the exhaust valve rockers having a common bush for each pair. Two collars turned on the bush near its centre locate the inner ends of the exhaust valve rockers, whilst the location of the bush on the support shafts is fixed by two split collars which are clamped to the shaft, one at each end of the bush. The valves are machined from drop forgings of silicon-chrome steel. The duplicate valve springs are retained by collars which are secured to the valve stems by the usual split-cone device.

Forced lubrication to all bearing surfaces is provided by a gear-type pump, this and two scavenge pumps being housed in a sump formed at the rear end of the crankcase. The dry-sump system is employed, the oil being fed from and returned to a separate service tank which may be fitted in any suitable position in the aircraft. The pressure pump supplies oil to the crankshaft journals and crankpin bearings and thence, *via* the big-ends, through pipes fitted to the webs of the connecting rods, to the gudgeon pin bearings. A relief valve fitted on the delivery side of the pump regulates the pressure and also acts as a reducing valve to by-pass oil at a lower pressure to the airscrew shaft reduction gear, the auxiliary drives, and the camshafts bearings and valve gear. The rocker support shafts act as oil leads to supply each of the rocker bearings, from which the oil passes into ducts drilled through the rocker arms to supply oil to the bearing faces in contact with the cams.

The reduction gear teeth are lubricated by twin jets which direct oil on to the wheels as they come into mesh. The used oil drains into a well at the forward end of the crankcase, from which it is drawn by a lead from one of the scavenge pumps and is thus returned to the sump at the rear end of the crankcase, where a second scavenge pump returns it and the other used oil to the service tank. The main filter for the pressure pump forms a separate unit, and is intended to be fitted in an accessible position on the aircraft. Strainers are, however, fitted on the suction side of each of the scavenge pumps.

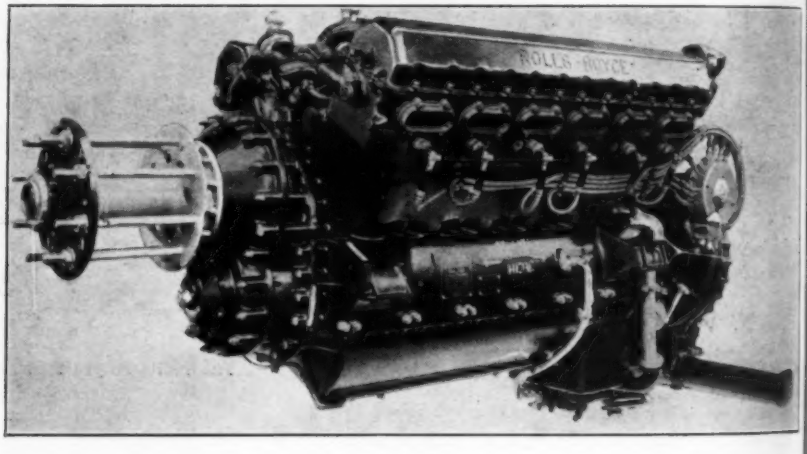
The water connections are simple, two leads being taken from the two outlets from the centrifugal pump to elbow joints fitted one at the rear end of the outer walls of each cylinder block casting. The water outlets lead inwards from the forward ends of the head casting, and meet in a common pipe which is taken between the cylinder blocks, horizontally, to the rear of the engine. This pipe supplies the carburettor jackets in the engines in which the carburettors are fitted between the cylinder banks. In the supercharged engines two separate outlet pipes are employed. The cooled water returns from the radiator to the centre of the pump casting, the inlet flange of which faces rearwards. In the non-supercharged engines the two Rolls-Royce duplex carburettors are fitted between the cylinder blocks, the air intakes projecting vertically upwards. Each carburettor is fitted with two throttles, these being interconnected to operate together by means of two pairs of toothed quadrants, thus all four throttles are operated simultaneously. The petrol flow to the jets is automatically regulated to compensate for the change in air density with changing altitude, communicating passages being provided between the throat and the float chamber of each carburettor to maintain the required pressure difference.

Two B.T.-H. magnetos are mounted at the rear end of the engine, one on each side of the auxiliary drive casing, and are driven by a common transverse shaft. Each magneto supplies 12 plugs, one per cylinder, the plugs being fitted diametrically opposite on the inner and outer sides of the combustion space. The coupling of the magnetos to the ends of the driving shaft is such as to enable the setting to be adjusted. Variable timing is provided, the operating levers being interconnected with the carburettor throttle and mixture regulating controls, so that the ignition timing is in effect automatically controlled by the throttle lever, no separate ignition control being required in the cockpit. A revolution indicator driving gear may be fitted at the rear end of one of the camshafts, the driven member running at one-fourth crankshaft speed. For service aircraft employing forward-firing guns provision is made for fitting cams to the auxiliary driving gear for the operation of the usual Constantinesco gun gear.

The supercharged F type engines are available in two forms, namely, the FX1 S, which is fitted with a supercharger designed to maintain normal power up to 11,500 ft., the engine being ground-throttled, or with a modified type of supercharger (FX1 M.S.) which is designed to permit a certain amount of boost at take-off and to maintain the normal horse-power up to 3,000 ft. The latter type is intended for use on aircraft in which maximum power is required for taking off on land or water. The full throttle output of this engine is 570 h.p. at 2,250 crankshaft r.p.m. the power at normal throttle opening and normal r.p.m. being 525 h.p. The nominal compression ratio of this engine is 5·5 : 1 and is therefore slightly lower than that of the normally aspirated FX1 A engine.

In the FX1 S engine a higher compression ratio is used, namely, 6 : 1, the main difference in the supercharger being that the rotor is geared to run at a higher speed. This engine is designed to maintain ground level power by increasing the throttle opening with increasing altitude, giving 490 h.p. at the full throttle altitude, at a normal crankshaft speed of 2,250 r.p.m.

As the only important differences between the FX1 S and FX1 M.S. engines are in the compression ratios and in the gear ratios of the supercharger rotor, their external appearances are practically identical. As compared with the non-supercharged F-type engine the main difference to be found is in the addition of the supercharger, with the consequent modification to the auxiliary gear housing, and in the location of the carburettors.



The Rolls-Royce F. type Supercharged engine.

Both superchargers are of the type in which the carburetted air is supplied, under pressure slightly in excess of the normal pressure existing in the induction pipe (the amount of excess pressure varying according to the type), to the induction system, the actual induction pipe pressure depending on the degree of throttle opening until the full throttle altitude is reached, when the power will fall off with increase in altitude in the usual manner. The supercharger consists of a centrifugal fan or rotor driven at high speed by the crankshaft through a suitable gearing, and is arranged between the carburettors and the induction manifold. The supercharger casing is bolted to the rear face of the auxiliary drive housing, and forms a separate and complete detachable unit, to the bottom of which the twin carburettors are mounted.

The supercharger rotor is fitted co-axially with the crankshaft, and is driven through a reverted train of sun and planet wheels which give a multiplying ratio of 5·5:1 in the case of the FX1 M.S. and 10 : 1 in the FX1 S engine, the rotor speeds being therefore approximately 12,375 and 22,500 r.p.m. respectively, at normal crankshaft speeds.

As it is not desirable to provide a positive drive for the rotor at these very high speeds, the planet wheels are frictionally driven by the sun wheel located at the rear end of the crankshaft. Each of the three planet wheels is therefore driven by a number of radial clutch segments which are

retained in engagement with rims formed on the inside of each wheel by light springs. Centrifugal force acting on the segments increases their clutching effect, the torque which can be transmitted through the clutches varying with the square of the crankshaft speed. As the torque necessary to drive the rotor similarly varies with the square of the speed the driving gear automatically adjusts itself to provide a predetermined margin of torque in excess of that which would cause slip to occur. The purpose of the friction drive is to protect the gearing from the damaging effects of jerky throttle movements with their resultant sudden acceleration or deceleration of the crankshaft, for although the rotor is made of aluminium alloy, at such high speeds it would possess sufficient inertia to strip the teeth in the event of rapid changes of speed, if a positive form of drive were employed. The arrangement of the rotor driving gear and the centrifugal clutches may be examined in the very interesting sectioned engine exhibited on the stand.

The supercharger casing is of volute form, the throats of the twin carburettors leading into a common passage which conducts the mixture to the centre of the rotor chamber, from which it is flung outwards by the rotor blades and enters the surrounding annular chamber at a very high velocity and passes thence to the induction manifold, through an outlet of large diameter leading from the top of the casing. The carburettors are of the submerged jet type, and deliver the fuel through diffusers into the main air stream. Two pilot jets and two small auxiliary diffusers are fitted for starting purposes, and the points at which these discharge into the main air stream at small throttle openings are adjustable relative to one edge of each throttle blade, so that a smooth change over from the pilot to the main jets is obtained as the throttle opening is increased. To compensate for the changes in mixture strength which would otherwise occur with the changes of air density with altitude, a hand control is fitted which operates a conical form of valve located in the fuel passage between each float chamber and its respective jet. The levers for controlling the twin butterfly throttles are carried by a transverse shaft mounted in bearings formed on the rear of the supercharger casing, near the top.

The magneto control is interconnected with the throttle control, and is arranged to advance the ignition timing automatically with increased throttle opening. The air intakes are bolted to either side of the carburettor body, and project at right angles to the axis of the engine, at either side. The carburettors are hot water-jacketed. Two separate water outlet pipes are taken to the rear between the cylinder blocks, these being connected at their forward ends by flexible couplings to elbow unions bolted to the water outlets formed integral with the forward ends of the water-jacket castings.

The HX engine is an enlarged model of the FX1 M.S. type; excepting the dimensions, it is similar externally and mechanically. The bore and stroke are 6 in. and 6·6 in., respectively, the normal power being 825 h.p. at a normal crankshaft speed of 2,000 r.p.m. The fuel consumption is 0·52 pint per b.h.p.-hour, and the oil consumption 9 pints per hour. An airscrew shaft reduction gear ratio of 0·477 : 1 is provided and the nominal compression ratio of this engine is 5·25 : 1. The design of the supercharger is similar in all respects to that previously described, and is of the moderate type, allowing the engine to develop full power at ground level.

The timing gears and all the auxiliaries on this engine and those of the supercharged F engine are driven through a torsionally flexible shaft in which the degree of twist is positively limited, as described with reference to the method of driving the auxiliaries of the earlier F-type engines. In the case of the supercharged engines, however, the friction-driven gears and the rotor form torsional oscillation dampers.

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THE SUNBEAM MOTOR CAR CO., LTD.

THE SUNBEAM CO., are showing two Sunbeam-Coatalen aero engines, together with various component parts. These engines will attract much attention, as one has the distinction of being the largest and most powerful exhibited, whilst the other is the sole representative of its type among the British engines at the show, as it is a compression-ignition, or Diesel type, engine designed to run at a comparatively high speed on heavy-oil fuel.

The larger of the two engines, the Sikh Series III, is a water-cooled 12-cylinder V-type airship engine, whilst the compression-ignition engine is known as the P.1. The Sikh has a rated normal output of 1,000 b.h.p., the airscrew shaft being gear driven. The P.1 engine is of small size for the type, having an output of 100 b.h.p. at 1,500 r.p.m.

It is of interest to recall that this month marks the tenth anniversary of the first return crossing by air of the Atlantic, by the British airship R.34, and that this historic flight was made possible by the five "Maori" 275 h.p. Sunbeam-Coatalen engines installed. Incidentally, the double crossing was not again accomplished until more than nine years later when the Graf Zeppelin successfully completed the trip.

The Sikh must be seen for its size to be appreciated, but some idea of the proportions of this engine may be gained from the fact that its length is over 7 ft., its width 3 ft. 4 in., and its height 5 ft. 4½ in., whilst the dry weight of the engine is nearly 1¼ tons.

The separate cylinders are arranged in two banks of six, with their axes at an angle of 60°, the two carburettors being arranged within the V. The overhead valves are push-rod operated from camshafts situated between the cylinder banks. There are two inlet and three exhaust valves to each cylinder. The cylinder barrels are turned from carbon steel billets and have cast steel heads, with integral water passages, screwed and welded to them. The water jackets surrounding the barrels are formed by corrugated casings of sheet steel which are welded to the barrels. The cylinders are deeply spigoted into the crankcase to increase rigidity and to reduce vibration, an unusual feature being that separate water jackets are welded to the barrels below the flanges securing them to the crankcase. The water spaces in the heads are supplied by a separate water lead, the common feed pipe being formed in sections cast integral with each head, flexible couplings forming the joints between each section of pipe.

The valve rocker gear is completely enclosed by an aluminium cover bolted to the top of each head. The rocker spindles are arranged with their axes parallel to the fore-and-aft centre line of the engine, the inlet valve rocker spindles being on the inner sides of the heads whilst the exhaust valve rocker spindles are fitted near the centre of the heads. Each group of valve-actuating arms is operated by an arm fitted at the end of each spindle, outside the rocker cover, the two external arms being fitted at opposite ends of the head. On the port bank of cylinders the exhaust valve rocker actuating arm is fitted at the rear side of each head, the inlet valve rocker actuating arm being fitted on the forward side, but this arrangement is reversed on the starboard cylinder bank.

The crankcase is an aluminium casting formed in one main portion, to the transverse webs of which the crankshaft bearing housings are bolted. The bottom of the crankcase is formed by a detachable sump, to the underside of which the water and oil pumps are secured. A timing gear cover is bolted to the rear end of the crankcase, whilst the forward end is closed by a circular cover forming the front of the reduction gear housing. The timing gear casing is provided with a platform at its upper end on which the two magnetos are mounted with their axes parallel, the distributors facing rearwards. Dry sump lubrication is employed, the main pressure pump being fitted on the underside of the sump and delivering oil to the journal bearings through a distributing tube cast in the crankcase. A second pump, formed as a unit with the main pump, supplies oil to the camshafts. Two scavenge pumps are provided, one at each end of the sump, so that the draining is not affected by the inclination of the engine.

The cooling water is circulated by two centrifugal pumps fitted below the sump, each pump feeding one bank of cylinders. The pumps are driven by vertical spindles, through spiral gears, from a common horizontal shaft. Each pump

supplies the heads through a main pipe, branch leads being taken to supply the jackets surrounding the barrels. Short outlet pipes are taken from the inner sides of the heads and meet in a common outlet pipe, one to each bank, these being coupled at their forward ends to form a common lead to the radiator. The two return pipes leading to the water pumps are also joined, having a common flange to which the return pipe from the radiator is coupled.

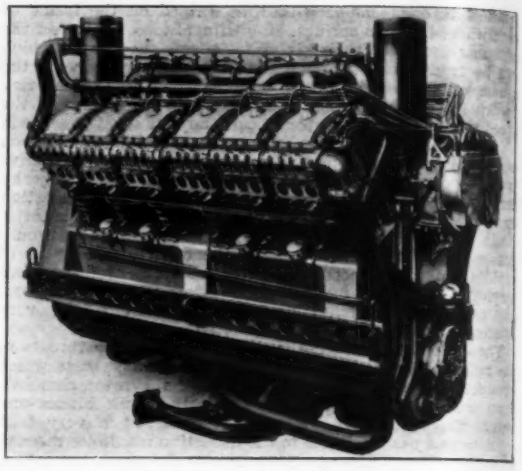
The two carburettors each supply six cylinders, three of each bank, at their respective ends of the engine. They are each bolted to twin water-jacketed chambers from which the pairs of three-branch steel induction manifolds lead to the inlet ports. Two vertical cylindrical funnels are fitted one at each end between the cylinder blocks, these forming the air intakes.

Ignition is provided by two B.T.-H. high-tension magnetos, these being fitted at the top of the timing cover at the rear end of the crankcase. The sparking plugs are enclosed within the valve rocker housings, the two H.T. leads to each cylinder being taken through a gland formed in the end wall of each rocker housing of the port cylinders and in the forward wall of the rocker housings of the starboard bank.

The type P.1 compression ignition engine is a most interesting power unit as its size and weight approximate to that of the average petrol engine of similar output. The six cylinders are arranged in line and are of the monoblock type. The bore and stroke are 120 mm. by 130 mm. respectively, the engine developing 100 b.h.p. at 1,500 crankshaft r.p.m., the airscrew shaft being directly driven. The consumption of heavy-grade crude oil is 0·4 pint per b.h.p.-hour and the lubricating oil consumption is ·03 pint per b.h.p.-hour.

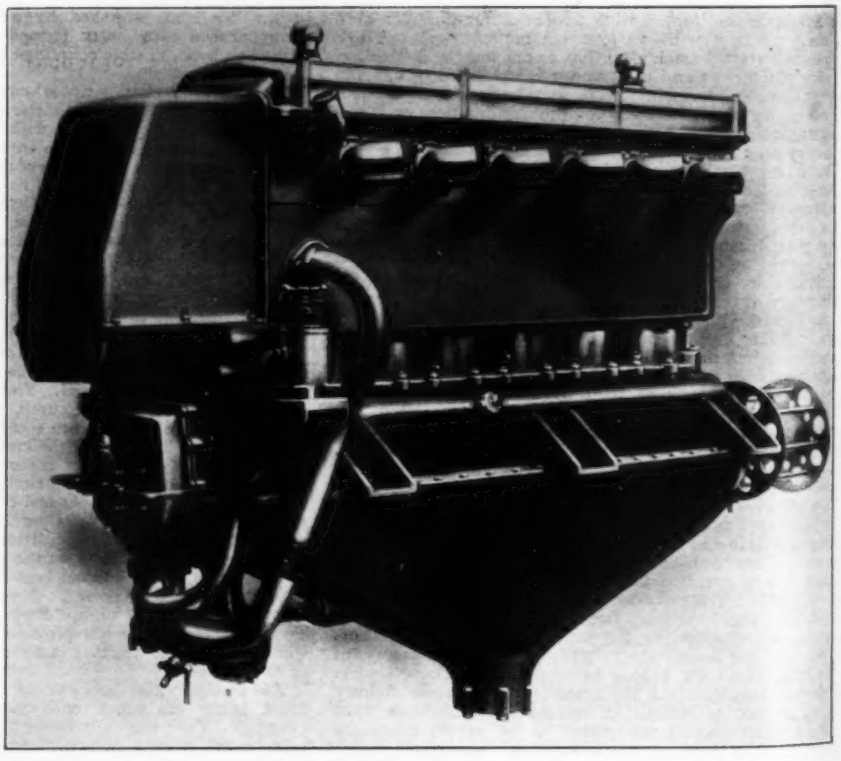
The extraordinarily neat external appearance of the engine will doubtless excite much admiration, though this is in a measure due to the absence of such external fittings as carburettors and magnetos with their attendant array of control levers, rods, and leads festooned about the cylinder blocks.

The advantages of the compression ignition engine are well known, these being briefly a higher thermal efficiency, resulting in economy in fuel consumption; reduction of fire risks due to the high flash-point of the fuel, this being practically non-inflammable under ordinary conditions, and greater reliability resulting from the absence of such accessories as magnetos, sparking plugs and carburettors. The item around which research on these engines has chiefly been concentrated during recent years is in the design of a satisfactory fuel injection valve. In this engine a special form of mechanically-operated valve is used which allows exact timing adjustment to be made, permitting higher crankshaft speeds to be attained and ensuring an equal output from each cylinder. The fuel valves are all fed from a common fuel pipe. A most important feature of the P.1 engine is that it may be started from cold without the assistance of any auxiliary apparatus.



The Sunbeam-Coatalen Sikh.

In addition to the two complete engines the Sunbeam exhibit also includes the crankshaft of a Sikh Series III engine, the finished weight of which is 2¼ cwt. whilst the rough forging weighs over 5 cwt. A connecting rod assembly and the reduction gear wheel of this engine are also being shown.



The Sunbeam-Coatalen compression ignition engine.

THE FOREIGN EXHIBITORS.

COMPARED with previous Olympia Aero Shows, the foreign participation must, this year, be characterised as good; but it would be idle to pretend that it is as good as had been hoped and expected. This applies particularly to the German exhibits. The German section had originally been planned as a combined exhibit by the Society of German Aircraft Constructors. Then the German Government decided on fairly drastic economies, which included and were particularly hard on the German aviation world. The result was that it had to be left to individual German firms to do the best they could. Thus, while Germany is certainly well represented, one cannot claim that she is adequately represented by four "life-size" machines. Models are all very well, but among some 70 actual aircraft they are apt to be overlooked. By a curious coincidence, the three European countries—France, Germany and Italy—are represented by four complete aircraft each.

FRANCE

THREE French aircraft firms are exhibiting machines: Farman Brothers, Liore and Olivier, and Henry Potez.

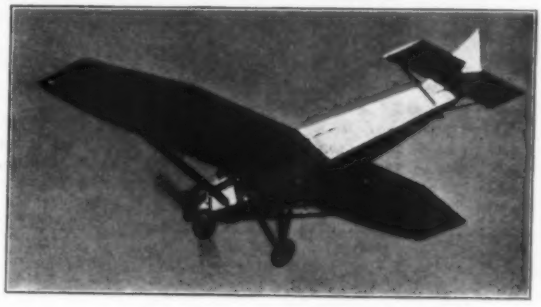
The Farman F. 190

This machine was first shown in public at the last Paris Aero Show. Since then it has been adopted by several air routes in France, and also the type has a number of notable flights to its credit, of which it will suffice if we mention the flight from Paris to Indo-China in 10 days, piloted by M. Bailly. The Farman F.190 can be equipped with various power plants of 230/250 h.p. At Olympia it is shown with the Gnome-Rhone "Titan" of 230 h.p.

The F.190 is mainly of wood construction, and is a high-wing strut-braced monoplane. The two wing-halves are attached to the top longerons of the fuselage, and are braced from the bottom longerons by sloping struts of duralumin. The attachment of the undercarriage is very neat: A bent axle and a radius rod on each side are hinged to the lower longerons. The telescopic strut is attached, at its upper end, to the front wing bracing strut, and the side load on the latter is avoided by running a strut from this point to the front spar at the point where the latter meets the top of the fuselage. The whole structure is thus triangulated, and this is accomplished with the smallest number of struts possible.

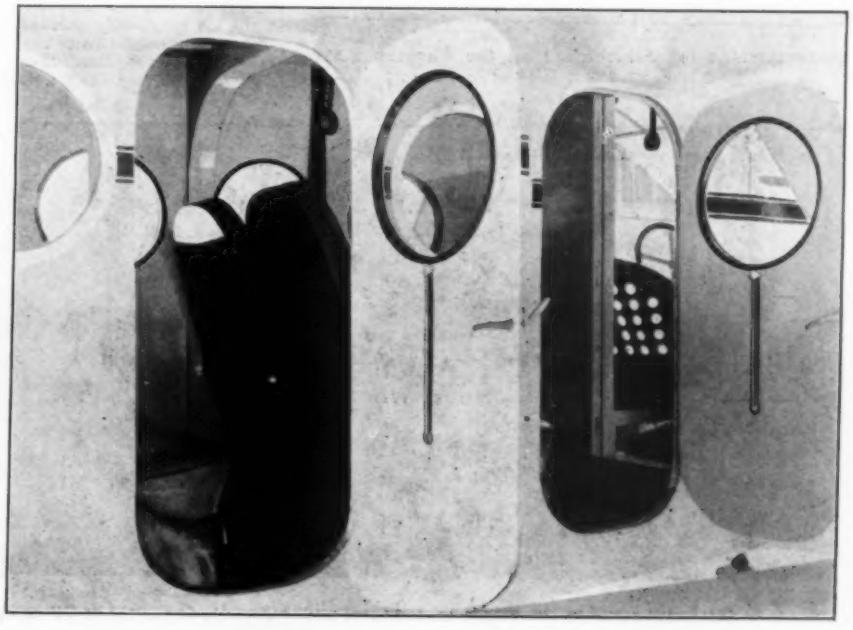
Another feature of the Farman F.190, which is not, however, evident from external inspection, is the extraordinarily low tare weight, and ratio of gross weight to tare weight. This results in a machine very economical to operate. Although having accommodation for pilot and three passengers, the F.190 weighs empty but fully equipped with seats, etc., 950 kg. (2,100 lbs.). The permissible gross weight is 1,688 kg. (3,700 lbs.), which leaves 1,600 lbs. for disposable load. According to range desired and load carried, this may vary in its composition, but a typical division is the following: Pilot, 80 kg. (175 lbs.), fuel and oil, 220 kg. (485 lbs.). This leaves a pay load of 438 kg. (960 lbs.), and as the range with this quantity of fuel is 850 km. (530 miles) such a pay load is unusually good (more than 4 lbs./h.p.) for a machine of this class.

The main dimensions of the Farman F.190 are: Length o.a., 10 m. (32·8 ft.); wing span, 14·1 m. (46 ft.); wing area, 40 sq. m. (430 sq. ft.).



The Farman F. 190 in flight.

Near the ground the machine has a full speed of 185 km./h. (112·5 m.h.p.). At 3,000 ft. the speed is 183 km./h. (111 m.p.h.), and at 2,000 m. (6,600 ft.) the speed is 178 km./h. (110 m.p.h.). The climb to 6,600 ft. occupies 17 mins. 48 secs. The cruising speed is 100 m.p.h., and the minimum speed 50 m.p.h.



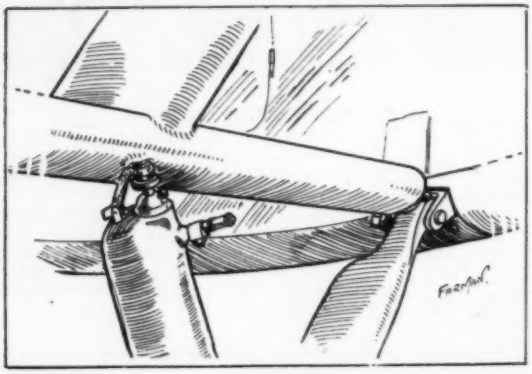
Looking into the Cabin of the Farman F. 190.

The Farman F.200 in flight.

The Farman F.200

This machine is, in a general way, similar to the F.190 from which it may be said to have been evolved, but is an open two-seater and fitted with the Salmson 120-h.p. engine. The petrol tank is in the wing. By slight modifications the machine can be converted for use as a mailplane, as a photographic machine, and as a school machine.

The main dimensions are: Length, 9 m. (29·6 ft.); wing span, 11 m. (36 ft.); wing area, 25 sq. m. (268 sq. ft.). The weight empty is 617 kg. (1,360 lbs.), and the gross weight, 1,000 kg. (2,200 lbs.). With a tankage of 156 litres (36·5 gallons) the range is approximately 650 km. (400 miles) at a cruising speed of 93 m.p.h.



Undercarriage leg attachment on the Farman F.190
("FLIGHT" *Sketch.*)

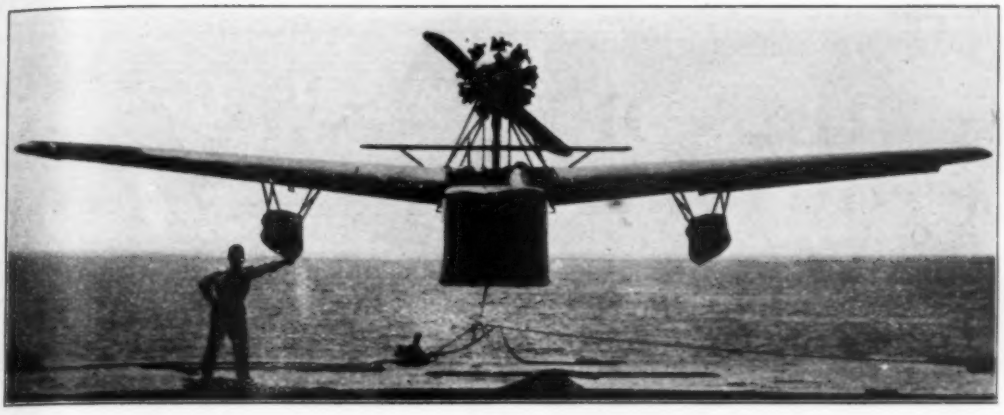
The LeO H.18

The firm Liore and Olivier exhibits the little two-seater flying-boat LeO H.18, which was shown at the last Paris Aero Salon. This machine, intended for training seaplane pilots, has been designed for extreme simplicity in construction and maintenance. The boat hull, of plywood, the wooden one-piece wing, also covered with plywood, and the complete engine unit are all easily detached and erected. Thus, the wing is secured to the hull by four bolts only, while the engine unit, complete in itself, is also attached to the wing by four bolts. The unit system is extended to the controls, which are again secured by four bolts.

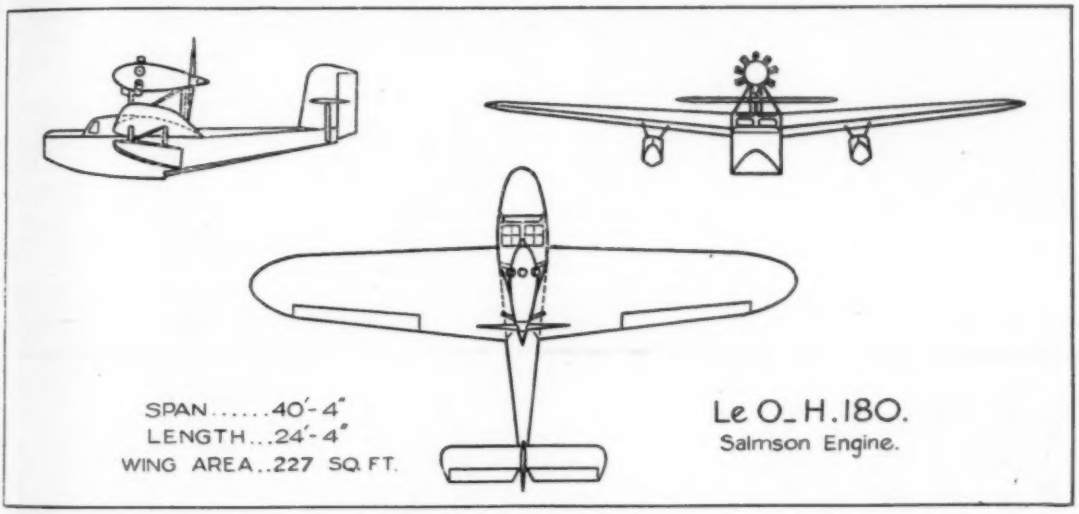
The hull is of the flat-bottomed variety, and of fairly large beam so that the two occupants, pilot and pupil, are seated side by side. If desired, the cockpit can be covered over with a cabin roof. The hull is divided into a number of watertight compartments, and as the wooden monoplane wing is also watertight, it is held that the machine should be practically unsinkable.

The main dimensions of the LeO H.18 are: Length, 7·44 m. (24·4 ft.); wing span, 12·55 m. (41·2 ft.); wing area, 21·1 sq. m. (227 sq. ft.); weight empty, 676 kg. (1,490 lbs.);

THE "LeO H 18": Fitted with a land undercarriage for trials at Villacoublay.



THE LIORE ET OLIVIER "LeO H 180": The machine as a seaplane.



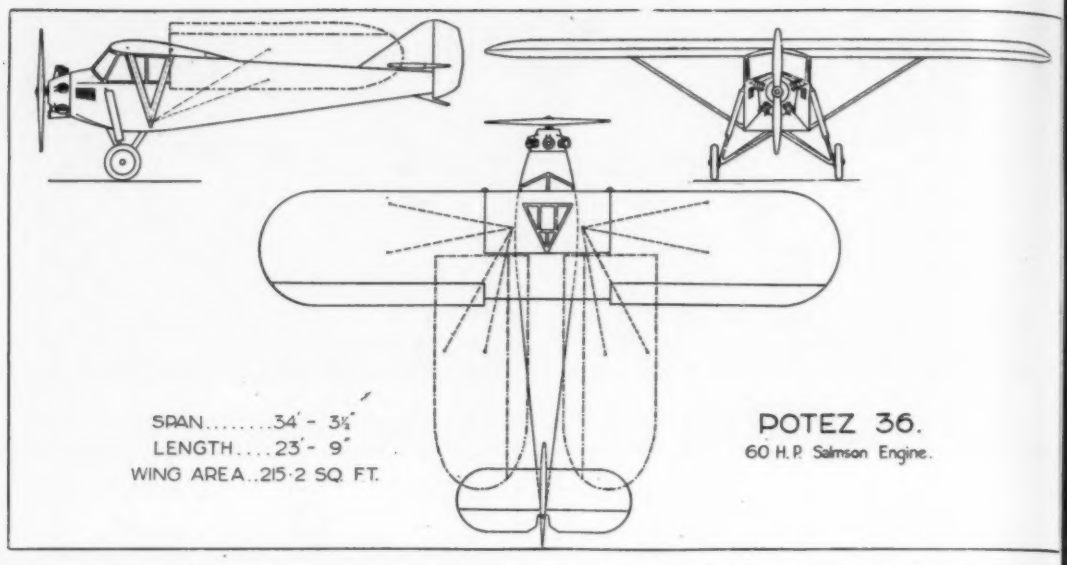
weight of fuel (for three hours), 74 kg. (163 lbs.); useful load, 180 kg. (396 lbs.). Total loaded weight, 930 kg. (2,049 lbs.).

The engine fitted is a 120 h.p. Salmson, but other power plants of similar power may be fitted instead. With this engine the performance is: Full speed, 165 km./h. (102 m.p.h.); cruising speed, 140 km./h. (87 m.p.h.); climb to 6,600 ft. in 20 mins.; service ceiling, 3,500 m. (11,500 ft.); range, 520 km. (320 miles).

The Potez 36

Henry Potez is one of the most successful French aircraft constructors of modern times. He came into the industry

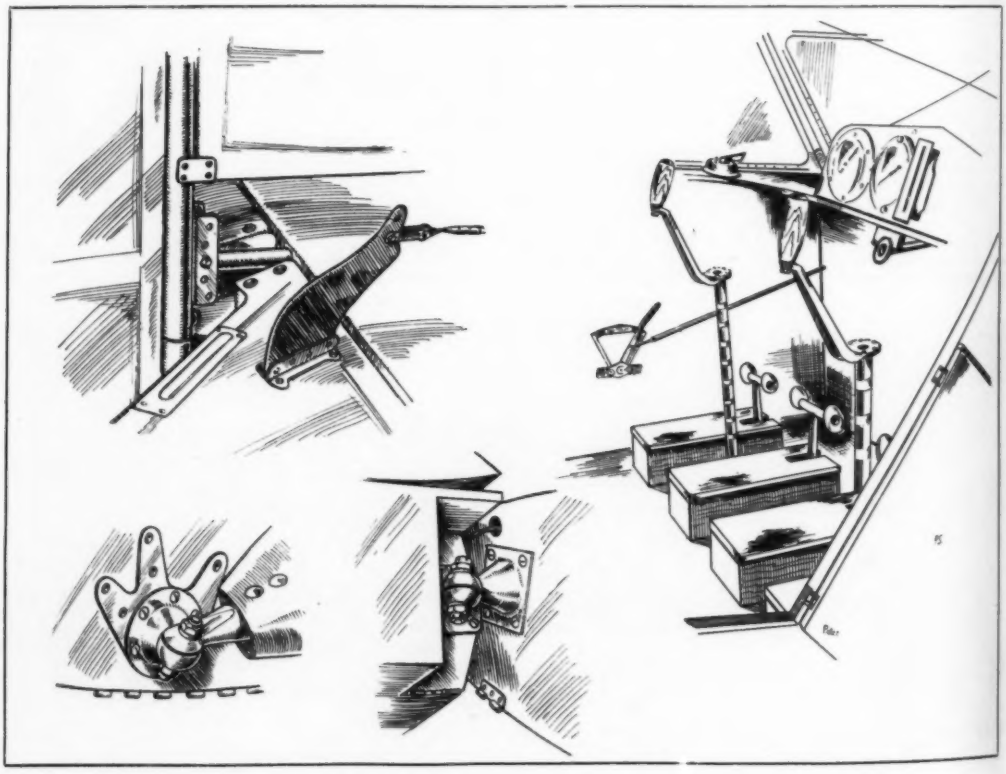
THE POTEZ 36: Fitted with 60-h.p. Salmson engine, this machine is a two-seater with "Conduite Interieure."



relatively late, but already more than 1,500 Potez machines have been sold and are in service at the present time. It is gathered that, realising the inevitable popularity of the two-seater light 'plane, Henry Potez has put the type 36, which is the one exhibited at Olympia, into quantity production. In this connection it might be recalled that at the first Paris Show after the war, Henry Potez exhibited a little two-seater with many interesting features, not the least of which was the engine, which was a four-cylinder in line air-cooled, but "standing on end" with its cylinder heads pointing forward and driving the airscrew through bevel gears. We have often thought that this arrangement had a good deal to recommend it, but the engine, for some unknown reason, never reappeared.

The Potez 36 is a two-seater light 'plane, with *conduite intérieure* and a 60-h.p. Salmson radial air-cooled engine. The wing, which is of wood construction, is of the monoplane type, attached to the top corners of the fuselage and braced by V struts to the lower corners. The wings are arranged to be folded, the arrangement being not unlike that of the Westland Widgeon.

The fuselage is a three-ply covered box in front, and



SOME DETAILS OF THE POTEZ 36 : In the top left-hand corner is shown the tail-plane incidence adjustment. Below, the type of hinges used in the wing-folding arrangement, and on the right, the unusual side-by-side control columns and rudder pedals. ("FLIGHT" *Sketches.*)

duralumin tube girder at the back, and the two seats are arranged in a cabin with side windows and a front windscreen. The undercarriage is of the divided type, with the telescopic legs hinged to the top longerons of the fuselage. The Salmson engine is mounted on a duralumin engine plate in the nose of the fuselage.

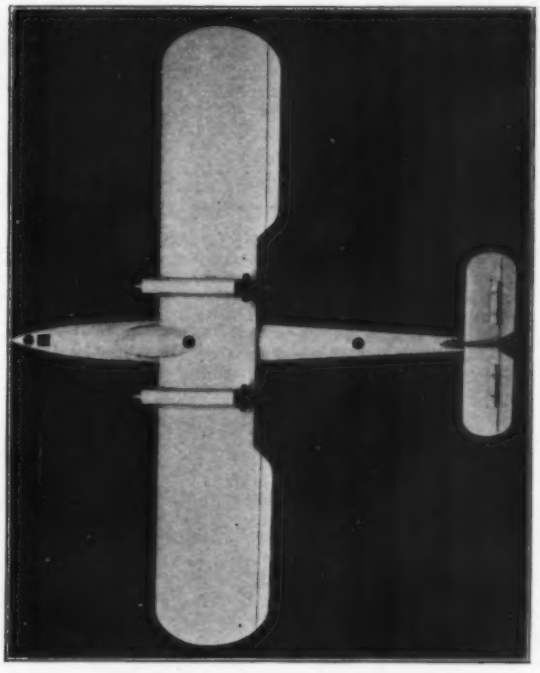
The main dimensions of the Potez 36 are as follows: Length, 7·5 m. (24·6 ft.); wing span, 10·45 m. (34·3 ft.); width with wings folded, 4 m. (13·1 ft.); wing area, 20 sq. m. (215 sq. ft.); tare weight with full equipment, 427 kg. (940 lbs.); weight of fuel, 44 kg. (97 lbs.); disposable load, 179 kg. (394 lbs.); total loaded weight, 650 kg. (1,431 lbs.). The top speed is 150 km./h. (93 m.p.h.), and the minimum speed, 60 km./h. (37 m.p.h.). The absolute ceiling is 3,600 m. (11,800 ft.).

GERMANY

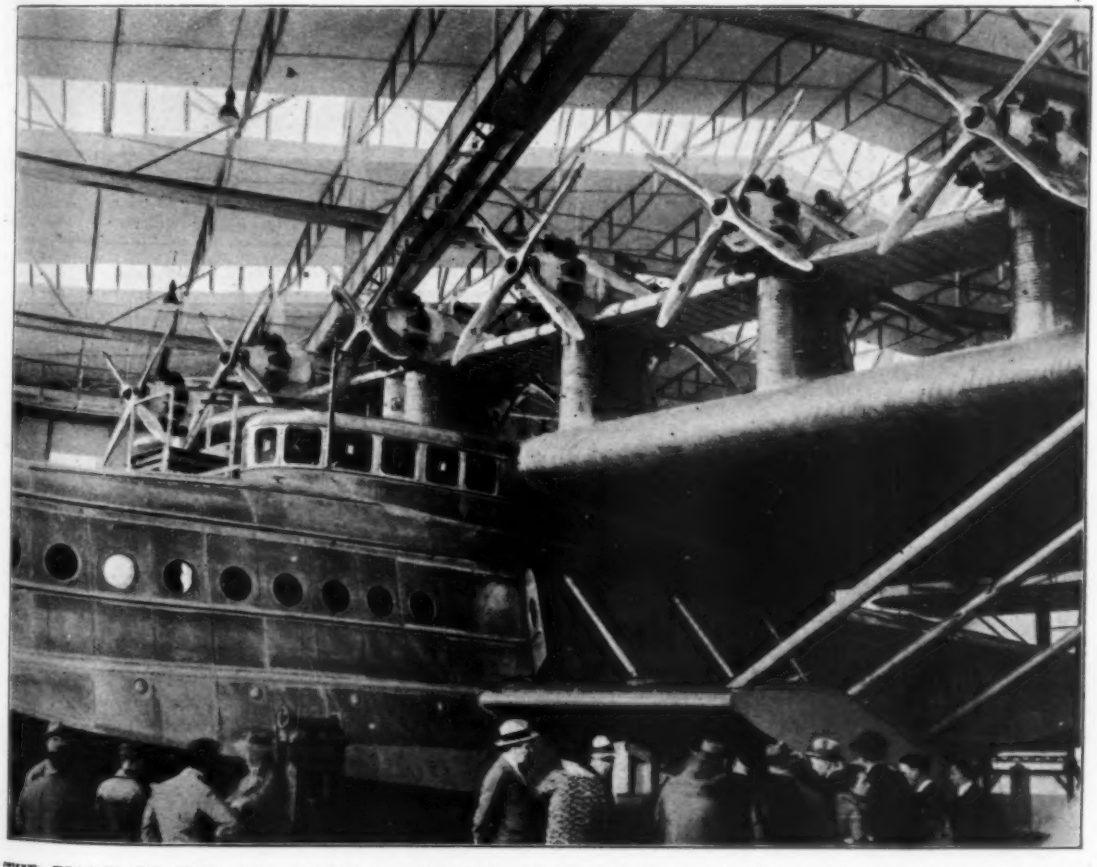
As already mentioned, the German exhibit is not as large as it might have been, nor by any means as large as one could have desired. But for all that it is a very interesting one. B.F.W., Heinkel, Junkers, Klemm, all exhibit actual machines, while the "Giants" (apart from Junkers) of the German aircraft industry, Dornier and Rohrbach, have had to rest content with showing models of some of their machines.

Bayerische Flugzeug Werke

The B.F.W. M.23, designed like a number of other recent B.F.W. machines, by Herr Messerschmitt, is a two-seater low-wing monoplane of wood construction, very similar in its general conception to the familiar Klemm monoplanes, but designed for engines of rather greater power, such as the "Cirrus" or "Genet." The wings are quickly detachable from the fuselage for housing or transport purposes. The undercarriage is of the divided type. The M.23 is a nice



Plan view of Scale Model of Dornier Do. S.



THE GIANT OF THE AIR: Unable to exhibit the actual machine, the Dornier firm is showing a scale model of the Do.X. This photograph, taken in the Dornier Works, shows the actual machine, and gives an excellent idea of the size.

straightforward design, but shows no unusual features calling for comment.

The dimensions, &c., of the M.23 are as follows: Length, 6·45 m. (21·2 ft.); wing span, 11·8 m. (38·7 ft.); wing area, 14·5 sq. m. (156 sq. ft.). When fitted with the Cirrus engine the machine has a tare weight of 320 kg. (705 lbs.). As the gross weight is 570 kg. (1,255 lbs.), the disposable load becomes 250 kg. (550 lbs.).

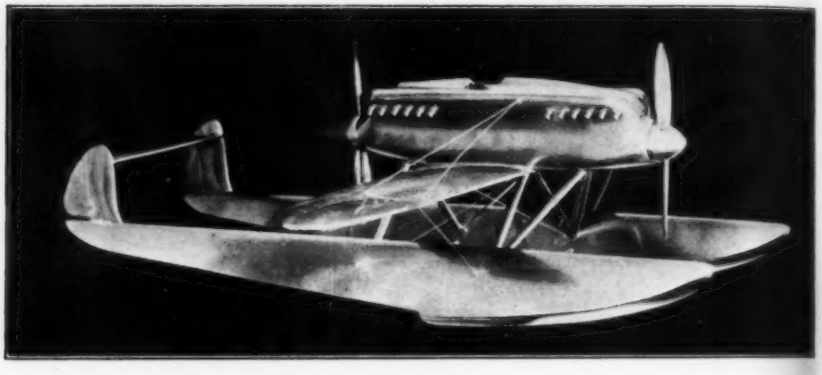
The full speed is given as 175 km./h. (108 m.p.h.) and the landing speed as 68 km./h. (42 m.p.h.). The climb to 1,000 m. (3,300 ft.) occupies 5 mins. 30 secs., and the ceiling is 5,800 m. (19,000 ft.).

The Dornier Models

By a happy coincidence (or was it design?) the first test flight of the new giant Dornier flying boat Do. X preceded the opening of the Olympia Aero Show by a few days only. As far as can be gathered, the first flight was a complete success. This only means, of course, that the machine got off and handled at least well enough in the air to be landed again safely; but that is at least something. With twelve engines developing something like 500 h.p. each, or a total of some 6,000 h.p., it may be argued that the machine *should* get off. While that is perfectly true, questions of controllability, behaviour on the water, and a number of other problems must be considered, and the Do. X is such a bold conception that there were many possibilities of errors in calculations and estimates. That the machine has got off and has alighted safely again is a very good beginning. Now remains to test it out with gradually increasing load. Unless the pay load per horse-power is reasonably good, and the machine can get off with the full load which corresponds with a reasonable pay load, it would remain an interesting but not entirely successful experiment. We can only await further developments. Machines are not unknown in this country, which, although of great size and very interesting as experiments in size, were a failure regarded as useful aeroplanes.

In order to give our readers an idea of the actual Do. X, we publish on p. 727 a photograph taken recently in the Dornier works on Lake Constance. The people walking about in front of the machine give scale to the picture and make one realise the ambitious nature of Herr Dornier's latest design. Fundamentally, a monoplane not dissimilar to previous Dornier machines, the Do. X has the same type of wing stumps projecting from the hull and serving to give lateral stability on the water. The engine arrangement is, however, unusual. Six pairs of engines, placed in tandem, are spread across a large portion of the wing. This, of course, helps to spread the load and thus reduces the stresses in the wing, the only concentrated load on which is that of the hull and contents thereof. Joining the six engine nacelles are a series of wing sections which have the effect of forming a small monoplane wing above the main wing. What exactly will be the aerodynamic effect of this arrangement seems somewhat doubtful. It is likely that the introduction of this wing is based upon structural rather than aerodynamic considerations.

The actual Do. X will undoubtedly carry a very large number of passengers. It would have to, in order to be of any practical use. How many we do not know at the moment. Likely this will depend upon the gross weight with which it is found possible to get off the water, and at present no figures are available concerning this. The only data which we have so far succeeded in obtaining relate to dimensions, the main ones of which are: Length, 40·05 m. (131·4 ft.); wing span, 48 m. (157·5 ft.); total wing area, 170 sq. m. (1,830 sq. ft.).

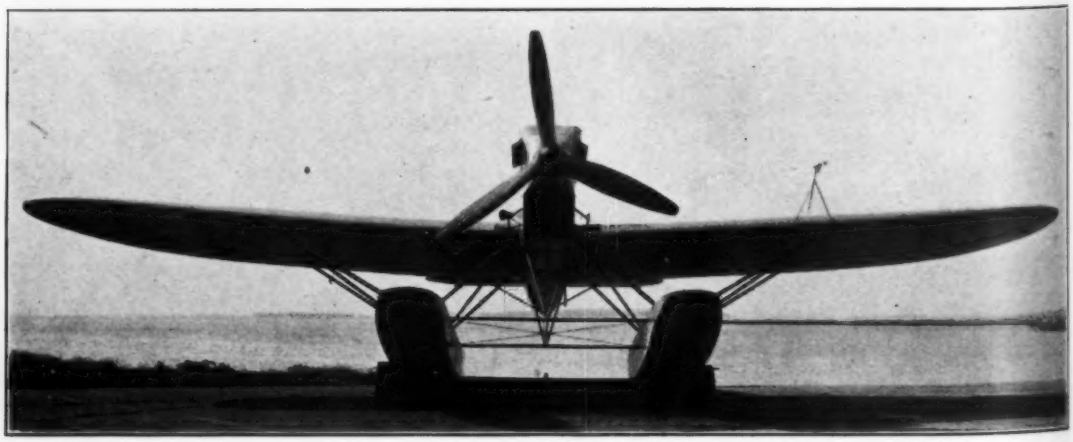


Scale Model of Dornier Racing Seaplane.

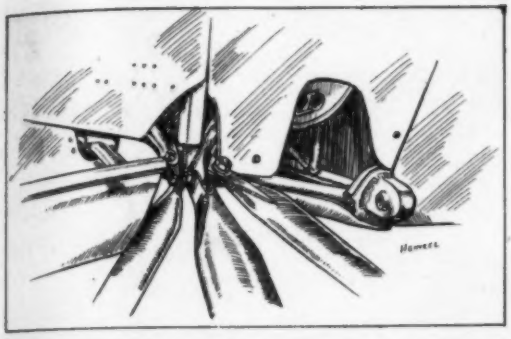
The Heinkel H.E.9 Seaplane

Dr. Ernst Heinkel is one of the pioneers of German aviation, having been actively engaged in design and construction since the earliest days of flying. At Olympia he is exhibiting a seaplane, the type H.E.9, with B.M.W. VI engine, developing 500/750 h.p.

The H.E. 9 is of typical Heinkel design, *i.e.*, a low-wing



THE HEINKEL H.E. 9: Of typical Heinkel design and construction, this machine is fitted with a B.M.W. VI engine.



Float struts and wing root attachments on the Heinkel H.E.9. (" FLIGHT " *Sketch.*)

monoplane with twin-float seaplane undercarriage. The fuselage is a steel tube structure in which longerons and struts are joined together by welding. Bracing is by diagonal struts, welded at the ends. The covering, except in the region of the engine, is fabric.

The wings are of wood construction, with box spars having spruce flanges and three-ply walls, and ribs of wood. The covering is fabric. Over the leading edge of the wings is a covering of three-ply to give stiffness, and in the inner bay the wings have their under-surface covered with three-ply to support and cover the petrol tanks housed here. The strutting supporting the floats is such as to provide also outboard bracing for the two wing-halves.

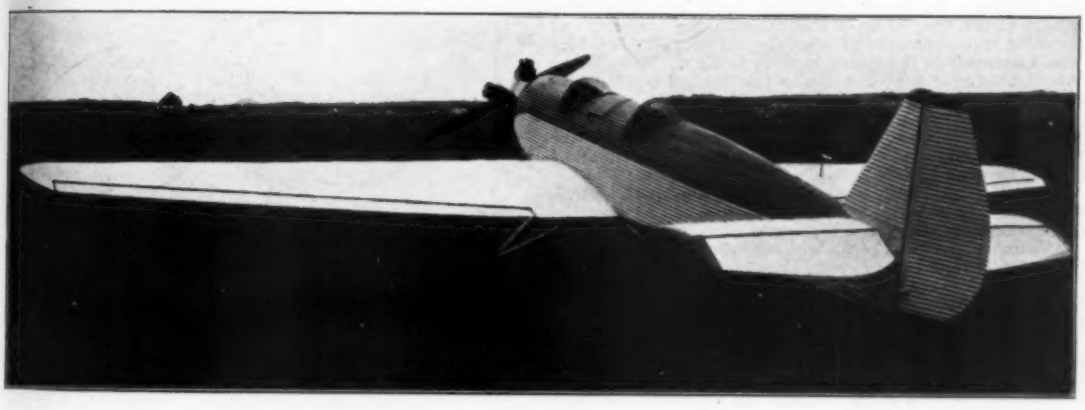
Two long wooden floats support the machine on the water. The floats are of the single-step type, and have a vee bottom in front of and behind the step. They are divided by six bulkheads into seven watertight compartments.

Mounted on a welded steel tube structure in the nose is the B.M.W. VI engine, which has a compression ratio of 7·5 to 1. The petrol tanks, of brass, are housed one in each wing, and supply to the engine is by pump. Between the engine and the cockpits there is a fireproof bulkhead. The aircraft controls are of normal type, with hand wheel for the rudder. The tail plane can be trimmed during flight.

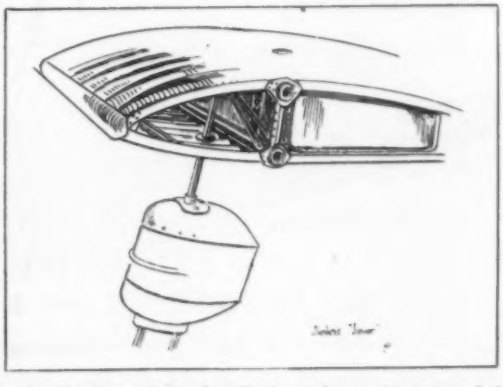
The main dimensions of the Heinkel H.E.9 are : Length, 11·6 m. (38·1 ft.) ; wing span, 16·8 m. (55 ft.) ; wing area, 48·5 sq. m. (522 sq. ft.). The tare weight of the machine is 2,130 kg. (4,680 lbs.) ; this figures includes oil and water in engine. The normal disposable load is 870 kg. (1,915 lbs.), giving a normal gross weight of 3,000 kg. (6,600 lbs.). The machine may, however, be overloaded to a gross weight of 3,150 kg. (6,925 lbs.). For normal gross weight the load may be made up as follows : Crew of two, 160 kg. (352 lbs.) ; fuel, 350 kg. (770 lbs.). (The tanks actually have a capacity for 500 kg. (1,100 lbs.) of fuel.) Military load, 360 kg. (792 lbs.). With a gross weight of 3,000 kg. (6,600 lbs.) the performance claimed for the H.E.9 is : Top speed, 250 km./h. (155 m.p.h.) ; climb to 1,000 m. (3,300 ft.) in 2·8 mins. ; to 2,000 m. (6,600 ft.) in 5·9 mins. ; to 3,000 m. (10,000 ft.) in 9·5 mins. ; to 5,000 m. (16,400 ft.) in 25 mins. Actually the performance figures obtained by the DVL during type tests were in all instances slightly better than those quoted. With 350 kg. (770 lbs.) of fuel the range is 600 km. (370 miles) and with full tanks, 500 kg. (1,100 lbs.), the range is 850 km. (525 miles).

The Junkers " Junior "

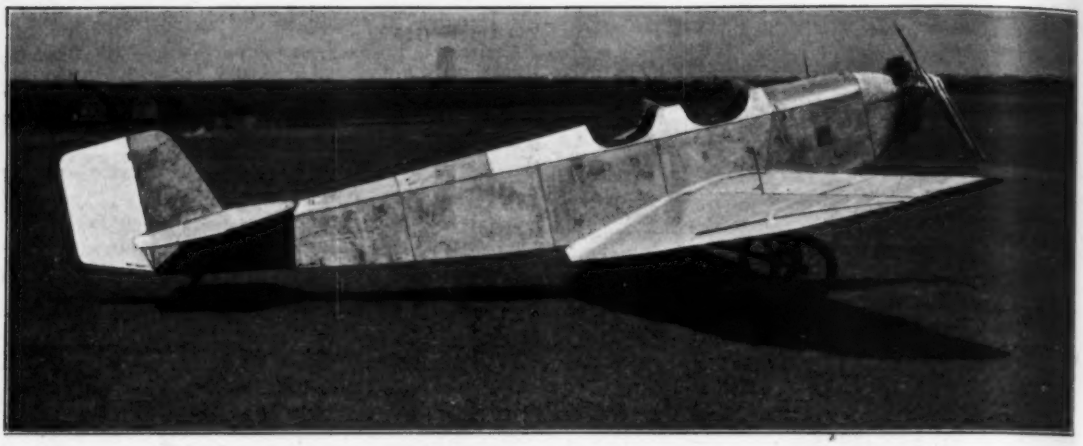
In view of the popularity attained in this country by the two-seater light 'plane and the modern tendency towards all-metal construction, it is interesting to see how a foreign aircraft constructor attacks the problem, especially when that constructor is one who has become world-famous as a constructor of larger aircraft. The Junkers " Junior," or A.50, to give it its official series number, follows closely previous Junkers practice in its design and construction. In spite of this, however, the tare weight of the machine is very low compared wirh British machines of similar class. In spite of the fact that it is a cantilever monoplane, the tare weight of the Junkers " Junior " is but 295 kg. (650 lbs.), a figure low enough to be rather startling, even making allowance for the low weight of the Armstrong Siddeley Genet engine with which the machine is fitted. The fuselage has an internal structure of duralumin tubing, and the bracing is entirely carried out by the covering, which is duralumin sheet with longitudinal corrugations. The wing is of typical Junkers construction, although the number of tubular spars has, in view, presumably, of the relatively small wing chord, been reduced to 4. The wing covering is also corrugated duralumin, and the corrugations run from leading to trailing edge. Exactly where all th



THE NEW JUNKERS LIGHT 'PLANE : The Junkers " Junior " is of all-metal construction. The engine is an Armstrong Siddeley " Genet."



On the Junkers " Junior " the telescopic strut of the undercarriage is attached to the centre section of the wing. (" FLIGHT " *Sketch.*)



THE KLEMM-SALMSON LIGHT 'PLANE : This machine is exhibited on the stand of S. T. Lea.

structure weight is saved is difficult to see. One assumes, of course, that the machine is designed to the usual DVL load factors. As in other Junkers machines, the centre section of the wing is built integral with the fuselage, and the wing end pieces are attached to the end of it by four "pipe unions" in the usual Junkers fashion. The ailerons extend from near the wing tips to the joint with the centre section.

The main petrol tanks, of a capacity of 80 litres (approximately 17½ gallons) are built into the centre section of the wing, and a gravity tank holding 12·5 litres (2¾ gallons) is housed under the deck fairing.

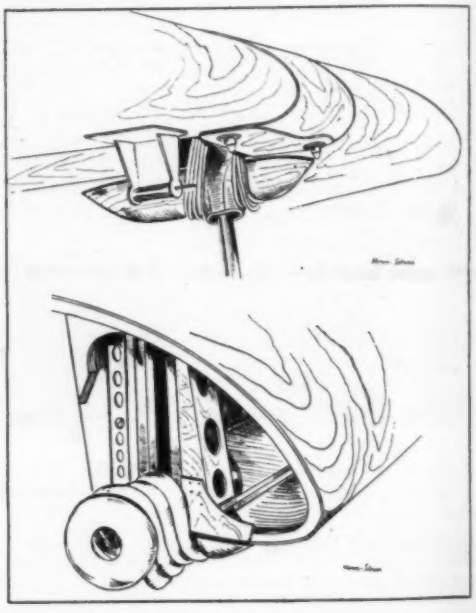
If the machine is intended for school work, dual controls can be quickly installed and one set again removed when the second occupant is merely a passenger.

The undercarriage is of the divided type, with wide track. If desired float or ski undercarriages can be supplied.

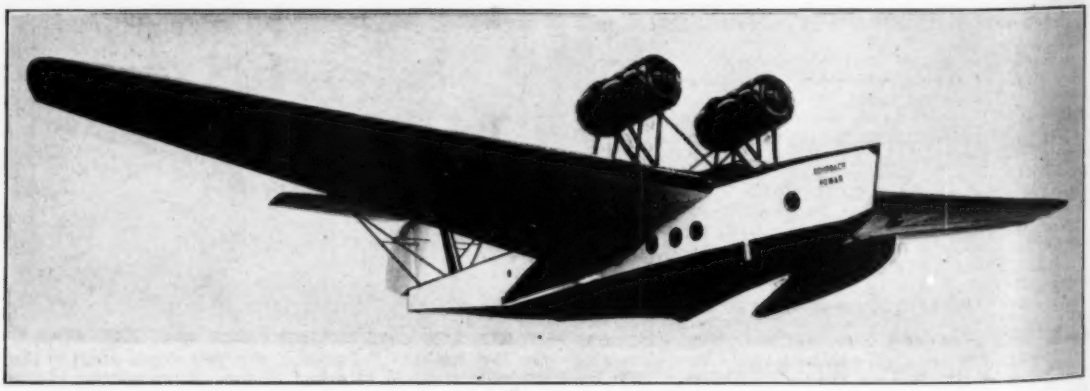
The overall dimensions etc. of the Junkers "Junior" are : Length o.a., 6·97 m. (22·9 ft.) ; wing span, 10 m. (32·8 ft.) ; wing area, 12·6 sq. m. (136 sq. ft.).

With a tare weight of 295 kg. (650 lbs.), the gross weight of the Junkers "Junior" may either be 500 kg. (1,100 lbs.) or 550 kg. (1,210 lbs.) according to whether the machine is being used for school work or for touring. In the latter case more fuel is carried. The normal gross weight of 500 kg. (1,100 lbs.) may be made up as follows : Tare weight, 295 kg. (650 lbs.) pilot and passenger, 150 kg. (330 lbs.) ; petrol, 45 kg. (100 lbs.); oil, 10 kg. (22 lbs.) ; total loaded weight, 500 kg. (1,100 lbs.). When used as a touring machine, the petrol load is increased to 65 kg. (143 lbs.) and the oil decreased to 8 kg. (18 lbs.), leaving a luggage, etc., weight of 32 kg. (70 lbs.) to make up the gross weight of 550 kg. (1,210 lbs.).

The *estimated* performance figures for the Junkers "Junior" are top speed near ground, 165 km./h. (102·5 m.p.h.); cruising speed, 135 km./h. (84 m.p.h.); landing speed approximately 75 km./h. (47 m.p.h.). The range is approximately 675 km. (420 miles) and the duration about 5 hours.



The shock absorbers are housed in the wing of the Klemm-Salmson. ("FLIGHT" *Sketches.*)



Rohrbach is showing a large model of the Romar.

Service ceiling, 4,500 m. (14,750 ft.). The following are the estimated climb times : To 1,000 m. (3,300 ft.) in 5·5 mins. To 6,600 ft. in 12 mins. ; to 10,000 ft. in 21 mins. ; to 4,500 m. (14,750 ft.) in 52 mins.

The Klemm-Salmson

The L.25 monoplane of the Klemm Light 'Plane Works is being exhibited on the stand of S. T. Lea, who is sole concessionnaire for the British Empire. The machine is already well known in this country, having visited a number of light 'plane meetings and clubs throughout the country. It is fitted with the 40 h.p. 9-cylinder Salmson engine. The L.25 is a two-seater dual control light 'plane, of the low-wing monoplane type. Both fuselage and wings are plywood-covered, the wings from rear spar to trailing edge being, however, fabric covered. The wing can be dismantled from the fuselage as a unit. The seating accommodation is the usual, with two cockpits in tandem. The undercarriage is of the split type. With a petrol capacity of 22 gallons, the range of the Klemm L.25 is approximately 600 miles.

The tare weight of the L.25 is 600 lbs., and the disposable load 400 lbs., giving a gross weight of 1,000 lbs. The top speed is 85 m.p.h. and the landing speed about 30 m.p.h. The dimensions are : Length, 23 ft. 8 in. ; wing span, 42 ft. 8 in. ; wing area, 215 sq. ft.

The Rohrbach Romar Model

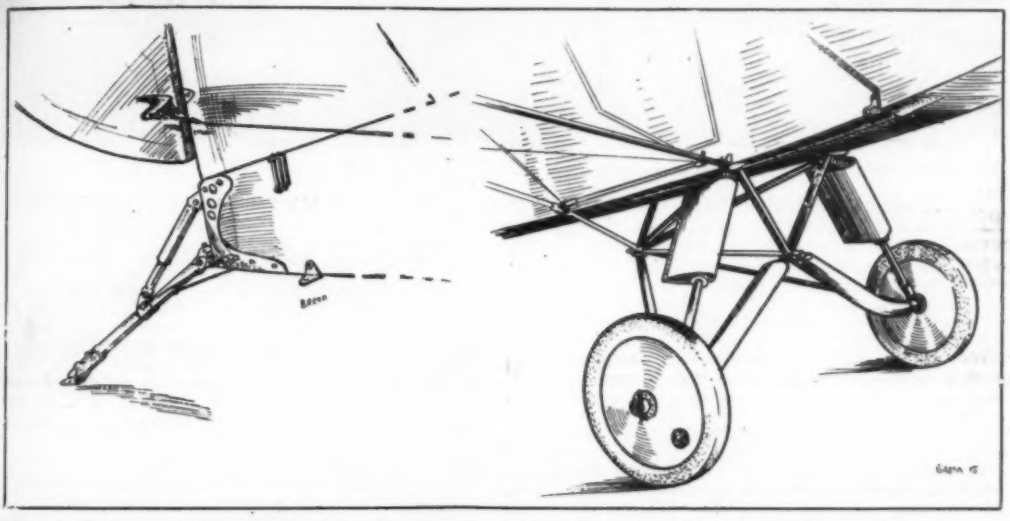
Having no small machine which could be exhibited at Olympia, and his Romar being a very large machine and therefore expensive to transport, Herr Rohrbach has had a very large scale model of the Romar prepared, and this is exhibited. The model is to a scale of 1 : 7·5, so that its length is more than 10 ft. and the wing span approximately 15 ft. One side of the model is hinged so that one may look into the interior and see the arrangement of cabin, etc.

ITALY

ITALY is represented by four complete machines, of which three are exhibited in the annexe on the stand of the Italian Air Ministry, while the other, a Fiat, is exhibited on the F.I.A.T. stand in the main building.

The Breda 15 Monoplane

Owing to the fact that the Olympia Show did not open until Tuesday of this week, and that these articles had



ON THE BREDA 15 : On the right the split undercarriage, and on the left the tail skid. (" FLIGHT " *Sketches.*)

AN ITALIAN CONTRIBUTION : The Breda 15 is a cabin two-seater light 'plane with Colombo S.53 engine. (" FLIGHT " *Photo.*)

AN ITALIAN PARASOL MONOPLANE : The Romeo Ro. 5 has folding wings. (" FLIGHT " *Photo.*)

to be prepared in advance, it has not, unfortunately, been possible to obtain very much information concerning some of the foreign machines exhibited. Among the machines to which this applies is the little Breda 15, exhibited in the annexe. The machine was on the stand when our representatives paid a visit, but there was no one present who could give detailed figures relating to the machine, and we have, therefore, to confine ourselves to giving the results of an external inspection.

The Breda 15 is a high-wing monoplane two-seater, in which the occupants are accommodated in a small cabin under the wing. The fuselage is a plywood-covered structure, and there are two doors leading to the cabin. The pilot occupies the rear seat, and enters the cabin through a door on the port side. The passenger or pupil (the machine has dual controls) is provided with a door in the starboard side. As the deck fairing of the fuselage drops away in front of the windscreen, the view from the front cockpit is very good, although one would imagine that the view from the rear seat is somewhat obscured by the passenger in front.

The monoplane wings are attached to the top corners of the fuselage, and are arranged to be folded back. An undercarriage of the split type is fitted. The engine is a four-cylinder-in-line air-cooled. We hope to give weight and performance figures of the Breda 15 in next week's issue.

The Romeo Ro. 5 Parasol Monoplane

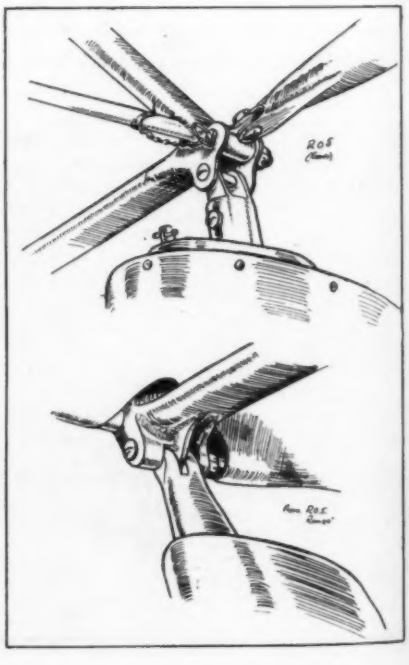
In dealing with the Italian exhibits in alphabetical order we should here jump from the annexe to the main hall, but for the convenience of visitors we propose to refer first to the Romeo monoplane exhibited beside the Breda 15. This machine is a Romeo type Ro. 5, fitted with a seven-cylinder radial air-cooled Fiat engine. The machine is a strut-braced parasol monoplane, of the " open " type, and is of composite construction. The fuselage, of square cross-section, is a girder composed of steel tubes welded together at the joints, and with the wire bracing attached to small steel tube quadrants in the Fokker style.

The wings appear to be of wood construction, and are designed to fold back, the front lift strut attachment to the fuselage being provided with a quick-release device for the purpose. The undercarriage is of the split type.

The Fiat seven-cylinder radial air-cooled engine is mounted on a welded steel tube structure in the nose of the fuselage, and there is a petrol gravity tank in the top centre-section of the wing. Neither dimensions nor weight and performance figures are available at the moment of going to press, but we hope to give these next week.

The Fiat C.R.20

On the Italian stand in the annexe is also exhibited an Italian service machine, the Fiat C.R.20, fitted with 450 h.p. Fiat engine. This machine, although of Fiat design, was, we understand, constructed by the Macchi factories. Certainly the very beautifully-made wooden floats were made by that firm. The machine, concerning which, unfortunately, but little information can be obtained, is a single-seater fighter, of all-metal construction with the exception of the



Front chassis strut and leg attachments on the Romeo Ro. 5. (" FLIGHT " *Sketches.*)

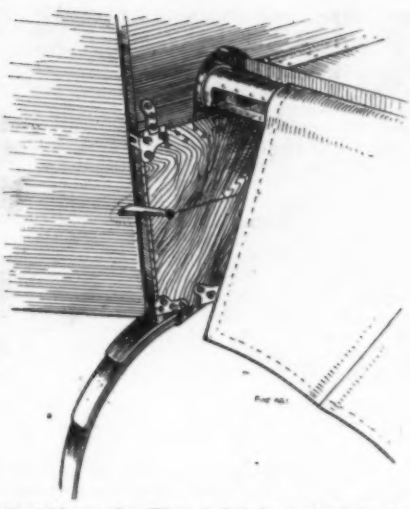
floats, and is unusual in that it has rigid wing bracing in the form of a Warren girder. The floats bear strong evidence of Schneider Trophy influence in their design, and indicate how racing has, in this instance, taught the constructors something which can be applied to a service type of machine. The Fiat C.R.20 shows the usual broad and flat nose radiator which one associates with the machines of this firm, and is very like a machine exhibited at one of the Paris Aero Shows, when, however, the fighter exhibited was a landplane.

The Fiat A.S.1.

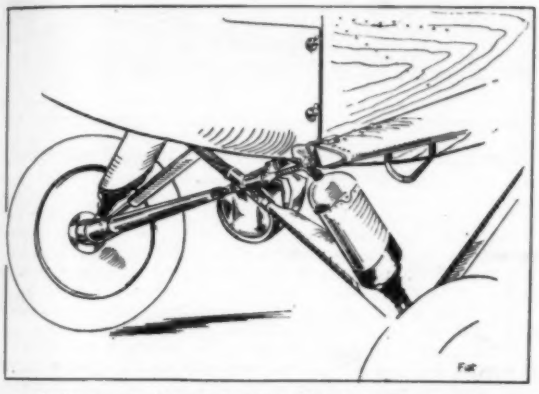
The light 'plane exibited on the F.I.A.T. stand in the main building is a parasol monoplane two-seater of composite construction. The engine is a Fiat type A.50 seven-cylinder radial air-cooled of 85-95 h.p.

Although our photographs show it as a coupé monoplane, the Fiat A.S.1 can actually be converted into, and is exhibited as, an open touring machine by removing the transparent coupé top. Another modification possible is the substitution of a twin-float undercarriage, turning the machine into a seaplane.

The fuselage of the Fiat A.S.1 shows the plywood covering which is becoming almost universal for light 'planes. In front the fuselage is fitted with two doors, one for each cockpit, and the nose of the machine is formed by a duralumin plate carried on duralumin tubes from the fuselage structure proper.



The tail skid on the Fiat A.S.1 is a steel leaf spring.
("FLIGHT" *Sketch.*)



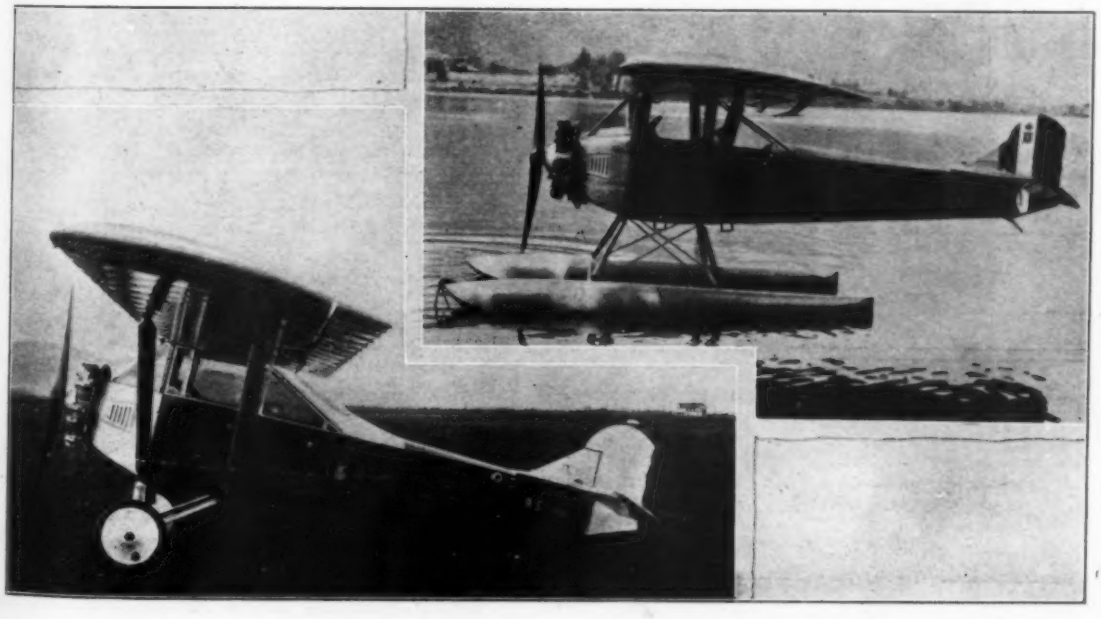
Undercarriage and landing light on Fiat A.S.1.
("FLIGHT" *Sketch.*)

Constructionally, the monoplane wings are of orthodox type, with wooden spars and ribs and fabric covering. They are hinged on the rear spars and when folded back along the fuselage the overall width of the machine is reduced to less than 11 ft. The folding operation can be carried out in less than 5 mins.

A vee type of undercarriage is fitted, the shock-absorbing medium being rubber blocks working in compression, with metal separator plates and cylindrical containers. The tail skid is a laminated steel spring.

As already mentioned, the Fiat A.50 engine is mounted on a duralumin plate in the nose of the machine. There are two petrol tanks, one in the centre-section of the wing and one in the fuselage. The total capacity of the two tanks is 150 litres (33 gallons), which suffices for a flight of some 7¼ hours' duration, and gives a range of approximately 1,000 km. (620 miles).

The two seats are so constructed as to afford space for a



THE FIAT A.S.1: At Olympia the machine is shown as an open landplane. These views show it as a coupé landplane and as an open seaplane.

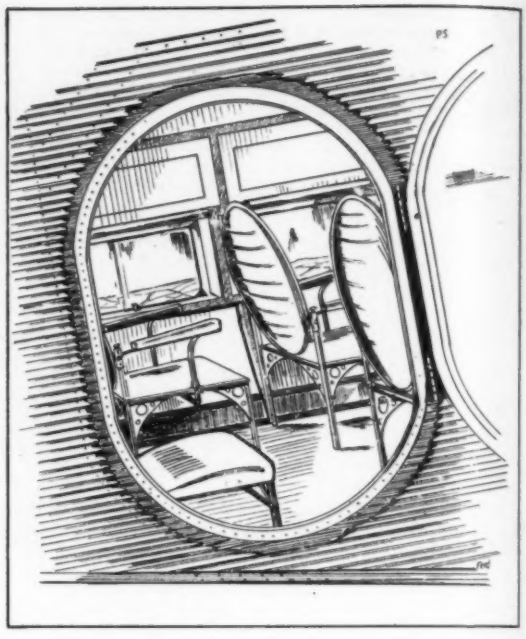
'Salvator" type parachute, which is strapped on the back and forms a cushion for the back rest. The forward cockpit is capable of being converted to hold two seats, thus turning the machine into an "occasional" three-seater. Dual controls are fitted, and there is an arrangement whereby the pilot can, at any moment, throw the pupil's controls out of gear by moving a lever forward. A catch holds the lever forward and the front controls out of action until the pilot again releases the catch.

The main dimensions of the Fiat A.S.1 are :—Length, o.a., 6·277 m. (20·6 ft.); wing span, 10·4 m. (34·1 ft.); wing area, 17·5 sq. m. (188 sq. ft.).

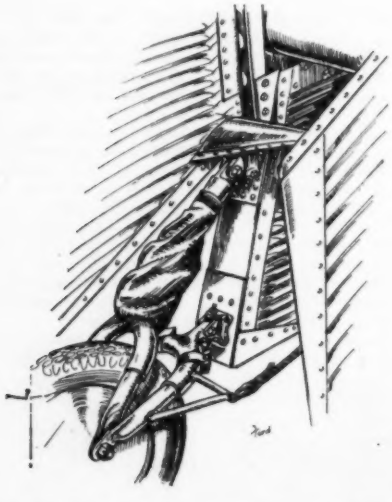
With a tare weight of 390 kg. (858 lbs.) and a gross weight of 670 kg. (1,475 lbs.), the Fiat A.S.1 has a disposable load of 280 kg. (616 lbs.). The maximum speed at ground level is 170 km./h. (105 m.p.h.), and full speed at 10,000 ft. is 160 km./h. (100 m.p.h.). The climb to 1,000 m. (3,280 ft.) occupies 5 mins. 15 secs., and to 2,000 m. (6,600 ft.) in 13 mins. 25 secs. Climb to 3,000 m. (10,000 ft.) in 24 mins. Absolute ceiling, 5,400 m. (17,700 ft.).

U.S.A.

WITH the "boom" in aviation which the United States of America are now experiencing, there were doubtless many who had expected that at Olympia there would be quite an American "invasion." Unfortunately, this has not been the case, and America is represented by a single aircraft, the large Ford-Stout three-engined all-metal monoplane. What the United States lack in numbers, at the Show, the tri-motored Ford makes up in size and general impressiveness.



A peep into the saloon of the Ford tri-motored monoplane. ("FLIGHT" *Sketch.*)



A castor-action wheel is used instead of a tail skid on the Ford tri-motored monoplane. ("FLIGHT" *Sketch.*)

The Tri-motored Ford

The type of machine exhibited by the Ford Company at Olympia has been extensively employed in the United States by passenger-carrying air lines, and also by large business organisations desiring the advantages of private air transport facilities. After the closing of Olympia, the machine will, we learn, be flown on a demonstration tour of different European capitals, piloted by Mr. LeRoy Manning, chief of operations of the Ford Air Lines and senior test pilot of the Stout Metal Airplane Company.

The tri-motored Ford exhibited in the new hall of Olympia is of all-metal construction, and in this case, the term does mean all-metal, not only the coverings of the wings and fuselage being metal, but even the passengers' seats. Of the internal structure but little can be seen, but we gather that the cantilever monoplane wing has three main spars, with a subsidiary structure which, in conjunction with the

THE ONLY AMERICAN REPRESENTATIVE: The tri-motored Ford monoplane.

metal covering, maintains the aerofoil section. The wing tapers in plan and thickness from root to tips.

The fuselage also is covered with metal, the material used being a form of metal ply, consisting of an inner layer of duralumin and two outer layers of a very pure aluminium. The material is known as "Alclad," and the advantage claimed for it is that, the outer layers which are in contact with the air being almost chemically pure aluminium, the material resists corrosion to a remarkable extent. In appearance, the "Alclad" surface is very bright, and one might readily forgive the visitor to Olympia who, on seeing the machine, exlaimed: "Here we have the real super 'Tin Lizzie'." The cabin is roomy and well lighted, and has seating accommodation for 14 passengers, the seats being arranged along the sides, under the windows.

The two wing engines are suspended from the wing spars, and the telescopic undercarriage struts are taken, at their upper ends, to the inboard side of the engine mountings. Mudguards are fitted over the wheels, and independently-operated hydraulic brakes are provided. The usual tail skid is replaced by a trailing wheel.

The petrol capacity of the tri-motored Ford is 355 U.S.A. gallons (about 295 Imperial gallons), and 30 U.S.A. gallons of oil, 10 gallons for each engine. The engines are Pratt & Witney Wasps of 425 h.p. each.

With a wing span of 77 ft. 10 in. and an overall length of 49 ft. 10 in., the tri-motored Ford monoplane has a tare weight of 7,500 lbs. and a gross weight of 13,500 lbs., leaving a disposable load of 6,000 lbs. The ratio of load carried to tare weight is, therefore, very good indeed.

Very detailed performance figures are not available, but we are informed that the top speed is 135 m.p.h. and the cruising speed 115 m.p.h. These figures are exceptionally good, and would seem to indicate that the aerodynamic design of the Fokker is as efficient as is evidently the structural design.

"SOUTHERN CROSS" MAKES RECORD FLIGHT

AERIAL communications between Great Britain and the Dominions are certain developments in the near future, and any serious Empire flight which now occurs must spur that development on. We have just had a good example of these possibilities in the successful and record flight of the *Southern Cross*. This Fokker monoplane (Wright "Whirlwinds") landed at Croydon Aerodrome on July 10 after flying from Australia in less than thirteen days. Its actual time from coast to coast (12,000 miles) was 12 days, 14 hours, 18 minutes. This was a record time. It beat Sqdr. Ldr. Hinkler's time by about two days. In spite of this, however, Hinkler's flight was unsurpassed in many ways. For instance, he flew solo and in a light 'plane, the Cirrus-Avian, giving at the most 80 to 90 h.p. He had no wireless apparatus, and he was mechanic as well as pilot and navigator and organiser.

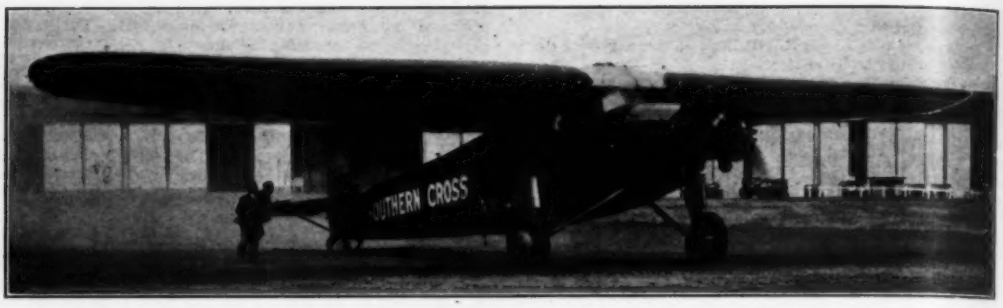
The *Southern Cross* had all the advantages that Hinkler lacked. It had three engines giving a total of about 600 h.p. It had wireless apparatus. The crew consisted of a pilot (Sqd.-Ldr. Kingsford-Smith), second pilot (Flight-Lieut. C. P. Ulm), wireless operator (Mr. McWilliams), and navigator (Mr. H. A. Litchfield), and they had the comfort and protection of an enclosed cabin. So Hinkler's flight stands as an unbeaten individual achievement, and in this respect it will possibly never be beaten.

No pilot could start a long flight of such magnitude with so little assistance as Hinkler had. But the *Southern Cross* flight is none-the-less a very valuable experience, and just the sort of experience which will raise immediate interest in longer air communications within the Empire. It will re-echo not only in Australia and Great Britain but in other Dominions.

The flight started from Sydney, N.S.W., on June 25 with a non-stop flight of 2,000 miles across Australia to Derby on the North-West coast, which was accomplished in 22 hours. Australia must have been greatly relieved when their safe arrival was announced, for it had been deeply disturbed by the unhappy results of the first attempt to fly across the Continent, when the *Southern Cross* made a forced landing and two lives were lost in the long search for them.

The next stage of the flight towards England led across the wide and isolated Timor Sea. It was a non-stop flight

SOUTHERN CROSS CREW:—Far from home but happy: (left to right), Mr. H. Litchfield, Flight-Lieut. C. Ulm, Sqd.-Ldr. Kingsford-Smith, and Mr. McWilliams. Thirteen days previously they were in Australia! ("FLIGHT" *Photo.*)



ACCOMPLISHED! Southern Cross monoplane makes the final landing of the Australia-England flight at Croydon, July 10. ("FLIGHT" *Photo.*)

of nearly 20 hours, made in fair weather. After the 600 miles of Timor Sea had been covered the airmen sighted the western end of Java at dawn, and they landed at Singapore. On June 30 another long stage was flown. This took them to Rangoon, where a slight delay occurred. Calcutta was reached on July 2. They left the next morning with the intention of flying over northern India to Karachi, but about noon another slight defect forced them to land at Allahabad. Karachi was reached two days later, and then followed a course up the Persian Gulf to Bunder Abbas. On the afternoon of July 7 came the landing at Baghdad.

Baghdad to Croydon—Two Days

The usual air route towards England from the Middle East is through Cairo, North Africa coast and Malta. The Australians, however, avoided this detour by flying direct to Athens from Baghdad on July 8. Strong head winds impeded this stage and threatened to bring the machine down, but it forged ahead and reached Athens two hours later than anticipated. Rome was a comparatively short stage the next day after the succession of long hops; and early on July 10 the monoplane left Rome for the 1,100-mile non-stop flight to Croydon.

During this stage wireless messages were received at the Air Ministry reporting the machine's progress. The last message from the machine was received at 3 p.m., reading, "Now heading inland over England. Loud cheers from the boys. Expect to land in 20 minutes."

Two machines ascended from Croydon to escort it, and there was a crowd to cheer the landing. Sir Sefton Brancker, representing the Air Ministry, was the first to welcome the Australians. Mr. C. W. C. Marr, a member of the Australian Government, was with Sir Sefton, whilst other greetings were extended from Commander H. Perrin, Secretary of the Royal Aero Club, and from representatives of Imperial Airways and the Australian High Commissioner's office.

Accompanied by Sir Sefton Brancker, the airmen were conducted to the Aerodrome Hotel for lunch. Describing the flight briefly, Sqdn.-Ldr. Kingsford Smith said that except for a few minor troubles the trip had been good. There were times when the engines had objected to the heat, but they did not let them down. The heat was terrific between Rangoon and Baghdad, but onward from there the weather was perfect.

Their chief purpose in visiting England was in connection with the purchase of four new Avro passenger aircraft fitted with Armstrong Siddeley "Lynx" engines, destined for Australian National Airways, Ltd., which has been formed by Sqdn.-Ldr. Kingsford-Smith and Flight-Lieut. Ulm to develop passenger and air mail services on the East Coast of Australia. Sqdn.-Ldr. Kingsford-Smith also mentioned that their flight to England had convinced him of the feasibility of an air line between England and the Dominion. Incidentally, he paid a warm tribute to Hinkler's Australian flight of 15½ days.

The following message was received by the Rt. Hon. Lord Thomson, Secretary of State for Air:—"Please convey to the four airmen of the 'Southern Cross,' my heartfelt congratulations on their remarkably successful achievement after all the dangers and hardships they have experienced."—(Signed) GEORGE R.I.

In conclusion, it should be remembered that the first flight from Australia to England was made by Sir Alan Cobham in 1926. It was the return journey of a round flight between England and Australia.

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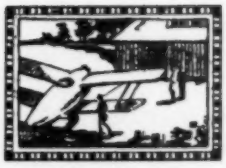
The Boulton & Paul "Phœnix" exhibited at Olympia is of wood construction, but the production machines will be all-metal.

PRIVATE  FLYING

A Section of FLIGHT in the Interests of the Private Owner, Owner-Pilot, and Club Member

MARCONI WIRELESS SET FOR LIGHT AEROPLANES

A LIGHT-WEIGHT wireless telephone set for use on light aeroplanes has been designed by the Marconi Wireless Telegraph Co., Ltd., to enable owner-pilots and clubmen to communicate while in flight with ground stations.

The weight of the new set, known as the Marconi Type A.D.22, has been reduced to about 60 lbs. It combines a telephone transmitter and receiver in a compact wooden box measuring only 16 in. × 9 in. × 7 in., and the total weight includes complete equipment with all accessories, such as the microphone and telephones, wind-driven generator, accumulator, aerial and connecting leads. It may thus be easily carried in all the popular types of light aeroplanes.

The "A.D.22" has been designed for the transmission of telephony only, as experience shows that the pilot, even if he is well acquainted with the Morse code, is usually sufficiently occupied with the controls and watching his instruments without being expected to concentrate on telegraph signals. With a power of 75 watts—equivalent to that used by many ordinary domestic electric lamps—the transmitter will cover ranges of 50-75 miles when communicating with the normal class of aerodrome ground stations, while with highly efficient ground stations, such as Croydon, ranges up to 100 miles are easily attainable. The reception range from modern aerodrome transmitters considerably exceeds these distances, and the A.D.22 receiver is, of course, capable of intercepting telegraph signals, both continuous wave and interrupted continuous wave, as well as telephony. For normal working the wave range of the transmitter and receiver is 850 to 950 metres, this being the international aircraft waveband, but a quick-change switch is provided to enable the 600-metres ships' wavelength to be employed in emergency.

The apparatus can be installed for operation by the passenger, or it may be fitted in any convenient part of the machine and operated by the pilot through a remote control unit, the tuning having been simplified to "one handle" manipulation.

Communication Facilities

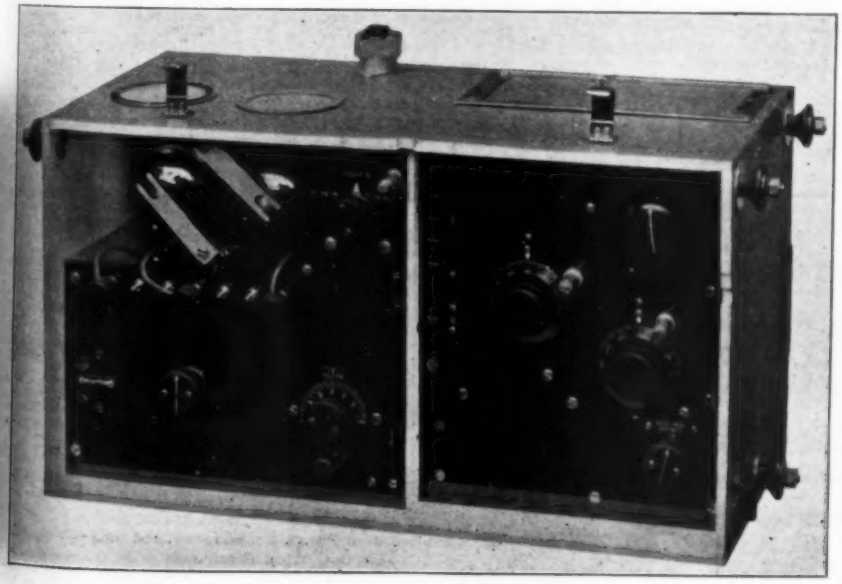
The amateur pilot is now enabled to take advantage of the wireless facilities for aircraft that are widely employed in commercial aviation, an advance that is very desirable in view of the rapidly increasing popularity of private air cruising on business and pleasure. Advice regarding weather ahead, state of the various aerodromes, and other information is made available to light aeroplane tourists, and in addition they are provided with a valuable means of position finding when flying over the Continent and other parts of the world where there are aerodrome ground stations equipped with wireless direction finders.

The importance attached to these services by aviation authorities is demonstrated by the fact that international regulations now in force practically throughout the world require all passenger-carrying commercial aircraft to be equipped with an adequate wireless installation. Lacking wireless the pilot is compelled to land to obtain information, incurring additional charges and possibly considerable delay. The principal reason for the limited use of wireless by private owners up to the present has been the fact that the wireless equipment designed and manufactured for use in commercial aircraft is usually too large and too heavy for light aeroplanes. While it was therefore necessary to design the new set along entirely new lines, the "A.D.22" embodies the wide experience of the Marconi Company in the manufacture of its standard aircraft sets, which are in regular use in civil, military, and naval aircraft in more than 30 countries and are standard equipment in all Imperial Airways machines.

Details of Components

The essential components of the transmitter and receiver are mounted in a light wooden box with strong lugs to which rubber shock absorbers can be attached when the set is fitted in the machine. The transmitter comprises an aerial tuning inductance with adjustments and switch for 900 and 600 metre wavelengths, an oscillation valve Type M.T.5 for energising the aerial circuit by means of a variable reaction coil and an anode tap connection on the aerial tuning inductance, and a modulating system consisting of a control valve Type M.T.5, connected in series with a speech choke.

The principal components of the receiver are a tuner with



A.D. 22: The new Marconi telephonic apparatus specially designed for light aeroplanes. It is only 16 ins. long and weighs 60 lbs. Transmission range is up to 100 miles, and the receiving range is above that.

slow motion condenser adjustment for high frequency selection, a single stage of screened grid high frequency magnification with valve Type S. 610, a detector with capacity reaction and valve Type D.E.L. 610, and a low frequency magnification stage with valve Type D.E.L. 610. The circuits employed in the receiver have been specially developed to ensure simplicity of operation, "one handle" tuning, smooth reaction, and a high degree of selectivity and sensitivity.

The microphone and telephones are designed for aeroplane work and are practically unaffected by engine noises. A generator of small and light construction provides both high- and low-tension current for the transmitter and receiver, the high-tension output being 1,000 volts 75 milliamperes, and the low-tension output being 7 volts 4 amps. It is fitted with a constant speed windmill which is self-regulating over a range of wind speeds from 70 to 170 miles per hour, thus ensuring a constant power supply.

LIGHT 'PLANE CLUBS

London Aeroplane Club, Stag Lane, Edgware. Sec., H. E. Perrin, 3, Clifford Street, London, W.1.
Bristol and Wessex Aeroplane Club, Filton, Gloucester. Secretary, Major G. S. Cooper, The Aerodrome, Patchway, Glos.
Cinque Ports Flying Club, Lympne, Hythe. Hon. Secretary, R. Dallas Brett, 114, High Street, Hythe, Kent.
Hampshire Aero Club, Hamble, Southampton. Secretary, H. J. Harrington, Hamble, Southampton.
Lancashire Aero Club, Woodford, Lancs. Secretary, Mr. Atherton, Avro Aerodrome, Woodford.
Liverpool and District Aero Club, Hooton, Cheshire. Hon. Secretary, Capt. Ellis, Hooton Aerodrome.
Midland Aero Club, Castle Bromwich, Birmingham. Secretary, Maj. Gilbert Dennison, 22, Villa Road, Handsworth, Birmingham.
Newcastle-on-Tyne Aero Club, Cramlington, Northumberland. Secretary, John Bell, Cramlington Aerodrome, Northumberland.
Norfolk and Norwich Aero Club, Mousehold, Norwich. Secretary, G. McEwen, The Aerodrome, Mousehold, Norwich.
Nottingham Aero Club, Hucknall, Nottingham. Hon. Secretary, Cecil R. Sands, A.C.A., 30, Park Row, Nottingham.
The Scottish Flying Club, 101, St. Vincent Street, Glasgow. Secretary, George Baldwin, Moorpark Aerodrome, Renfrew.
Southern Aero Club, Shoreham, Sussex. Secretary, Miss N. B. Birkett, Shoreham Aerodrome, Sussex.
Suffolk Aeroplane Club, Ipswich. Secretary, Maj. P. L. Holmes, The Aerodrome, Hadleigh, Suffolk.
Yorkshire Aeroplane Club, Sherburn-in-Elmet, Yorks. Secretary, Lieut.-Col. Walker, The Aerodrome, Sherburn-in-Elmet.

BRISTOL & WESSEX AEROPLANE CLUB, LTD.

(JULY 7-13).—Pilot instructor: E. W. B. Bartlett. Ground engineer: A. W. Webb. Machines in commission (2): XF, TV. Flying time for the week, 28 hrs. 5 mins. Pupils instructed and hours flown (11), 14 hrs. 20 mins. soloists and hours flown (5), 4 hrs. 20 mins.; licensed pilots and hours flown (13), 4 hrs. 50 mins.; passengers carried and hours flown (14), 3 hrs. 25 mins.

The Club closed for the 13th, and 78 members and friends trekked to the Pageant to see how it should be done. There is little to chronicle this week beyond the passing of three more "A" licence tests by the Hon. R. Westenra, Mr. L. M. Leaver and Mr. W. H. Amory, to all of whom our congratulations. The official summer holiday of the Club is the last half of August, but it is hoped that it will be possible to keep the Club open throughout that period. Mr. T. W. Campbell and Mr. Tratman have again generously helped us with joy-rides and instruction. As YH is undergoing overhaul, the Hon. H. C. H. Bathurst has very generously lent his Gipsy-Moth HF for instructional purposes.

CINQUE PORTS FLYING CLUB, LTD.

(JULY 7-13).—Pilot instructor: K. K. Brown. Ground engineer: R. H. Wynne. Machine: R.I. Total for week, 26 hrs. 5 mins. Dual: Mr. Hume 1 hr. 30 mins.; Mr. Brewer, 1 hr.; Mr. Wynne, 1 hr. 15 mins.; Mr. Martin, 30 mins.; Mr. Cooke, 45 mins.; Mr. Cox, 30 mins.; Mr. Hughes, 1 hr. Total (7 members), 6 hrs. 30 mins. Advanced Dual: Mr. Ellis 15 mins.; Mr. West 1 hr.; The Hon. T. A. Verney Cave 15 mins.; Mr. Richardson 30 mins. Total (4 members), 2 hrs. Soloists: Mr. FitzGerald, 30 mins.; the Hon. T. A. Verney Cave, 15 mins. Total (2 members), 45 mins. "A" pilots. Mr. Ellis, 2 hrs. 45 mins.; Mr. Richardson, 7 hrs. 15 mins.; Mr. R. Dallas Brett, 1 hr.; Mr. West, 2 hrs. 45 mins.; Mr. FitzGerald, 1 hr. 30 mins.; Mr. K. Edgson Wright, 30 mins. Total (6 members), 15 hrs. 45 mins. Tests (6), 1 hr. 5 mins.

Mr. Ernest Martin, of Folkestone, and Mr. H. C. W. Brewer, of Ealing, commenced flying instruction during the week; and the Hon. T. A. Verney Cave, who is an ex-service pilot, commenced flying with the Club. Mr. FitzGerald, who has also flown in the Service, passed his flight test for "A" licence on Monday, the 8th.

As the Club was closed on Saturday, the 13th, in view of so many members attending the R.A.F. Display at Hendon, the time for the week, with only one machine in commission, is remarkably good. We hope to have P.M. back in service on Wednesday, the 17th.

It is very satisfactory to know that in the Landing Competition recently flown at Heston by the Household Brigade Flying Club, second and third prizes were taken by members trained by the Cinque Ports Flying Club at Lympne—Mr. E. D. Somerset, of the Guards' Depot, Canterbury, taking second prize, and Mr. A. V. C. Douglas, of the Scots Guards, taking third prize. It is significant that Cinque Ports pupils have succeeded in winning some award or other in almost every competition for which they have been entered up to date, and it is very encouraging to have these successes following upon our two awards at Rotterdam.

Anyone who attends the Aero Exhibition at Olympia during the next fortnight who wishes to obtain particulars of the Club will find our new booklet entitled "Learn at Lympne" available on Stands 96 and 99 (A.D.C. Aircraft, Ltd., and Cirrus Aero Engines, Ltd., respectively) and upon the stand of the Royal Aero Club, while folders giving the prices of membership and tuition are available on the two stands of the de Havilland Aircraft Co., Ltd., Nos. A.16 and B.15. The booklet promises to be a great success, being attractively printed on art paper and illustrated by excellent photographs. This booklet will be sent, on application to the secretary, post free, on receipt of 6*d*.

On Sunday, the 14th, we had the pleasure of a visit from Air Vice-Marshal Sir Sefton Brancker, Director of Civil Aviation, in his X Moth G-EDCA.

Both G-EBRI and G-EBPM average the same figure for petrol consumption during June; this was at the rate of 4·124 galls. per hour. This consumption is exceedingly low for club work, and reflects great credit on our staff at Lympne. Oil-consumption figures were as follows: G-EBRI, 0·784 pint per hour; G-EBPM, 0·983 pint per hour. Both engines are Cirrus Mark II.

HAMPSHIRE AEROPLANE CLUB

(JULY 6-12).—Ground engineers: Messrs. E. Lenny, S. Riches and J. Elliott. Pilot instructors: Flight-Lieut. F. A. Swoffer, M.B.E., and Mr. W. H. Dudley. Aircraft: Avian G-EBVI and Spartan G-AAFR. Flying time for the week, 39 hrs. 50 mins. Pupils under instruction (26), 23 hrs. 15 mins.; soloists (10), 6 hrs. 50 mins.; "A" pilots (12), 7 hrs. 10 mins.; passengers (7), 1 hr. 25 mins.; instructors (solo and tests) (10), 1 hr. 10 mins.

The following members have joined this week:—Major Harrison, Messrs. Baker, Cockburn, Hendy, Perkins, Cliff and Gore. Mr. Endacott passed his height test on Thursday.

Members are reminded that the Club will be closed for the summer holidays from August 4 to 12, both days inclusive.

LANCASHIRE AERO CLUB

(JULY 7-13).—Flying time, 31 hrs. 5 mins. Instruction, 6 hrs. 45 mins. Solo flights, 19 hrs. 25 mins. Passenger, 2 hrs. 20 mins. Tests, 2 hrs. 35 mins. Instruction: With Messrs. Hall and Scholes: Garner, Moore, Ashworth, J. H., Taylor, S., Weale, Riley, Boon, Wilkinson, Faulkner, Corrigan, Grey, Greg. Machines in commission:—EC, QL.

Soloists (under instruction): Sellers, Serck, Foote and Maxwell. Pilots: Hall, R. F., Michelson, Mills, Goss, Weale, Lacayo, Ruddy, Hall, D. E., Gort, Goodfellow, Twemlow, Miss Brown, Meads, Garner, Brown, H. A., Harrison, Davies, R. G., Ashworth, W. Scholes, Elwell. Passengers: With Mr. Mills: Mr. Cliffe. With Mr. Meads: Mr. Goss. With Mr. Twemlow: Mr. Howe. With Mr. Scholes: Messrs. Lees, Golpin, Sellers. With Mr. Hall, R. F.: Messrs. Whitehouse, Fallon, Strain, Parkinson and Ashworth.

Flying times have been low owing to preparations for Blackpool and shortage of machines.

On Thursday, Mr. F. Ruddy lost a wheel taking off. Signals were made to him from the ground, and he made a perfect slow landing, damaging only the wing-tip and airscrew.

During the Club year ending on June 30, just under 1,100 hours were flown, a decrease of about 80 hours as compared with the previous year. On the other hand, nearly £300 more subsidy was earned owing to the increased number of new pilots trained. A satisfactory number of new flying members has been obtained during the year and the prospects for the coming year are in many ways the most hopeful in the history of the Club.

MIDLAND AERO CLUB

(JULY 7–13).—The total flying time was 47 hrs. 21 mins. Dual, 20 hrs. 10 mins; solo, 20 hrs. 53 mins.; passenger, 5 hrs. 10 mins.; test, 1 hr. 8 mins.

The following members were given dual instruction by Messrs. W. H. Sutcliffe and T. W. J. Nash, A.F.M.:—E. C. Merrick, R. Darlington, P. B. Hackitt, N. B. Tompson, R. G. Welch, J. E. Yardley, Mrs. Leigh Fermor, F. T. Lydall, J. A. Ridsdale, T. W. Wild, H. Coleman, A. P. Hunt, L. W. Farrer, G. Norton, F. G. Robinson, S. J. Eardley-Wilmot, B. P. A. Vallance, N. G. Tower, A. F. Hill, C. T. Davis, J. R. Bond, Major D. Thomson, H. E. Evans, H. Coleman.

"A" pilots:—E. P. Lane, E. D. Wynn, S. H. Smith, R. L. Jackson, J. K. Morton, H. J. Willis, W. Swann, C. W. Fellowe, R. C. Baxter, E. R. King, W. L. Handley, S. Duckitt, W. M. Morris, J. Rowley.

Soloists: R. G. Welch, K. S. Neale, P. B. Hackitt, J. R. Bond, F. G. Robinson, H. Coleman, H. E. Evans, H. G. Tower, A. P. Hunt, F. T. Lydall.

On Sunday the Club put in 18 hrs. 50 mins. flying, which broke the previous record by 2 hrs.

NORFOLK & NORWICH AERO CLUB

(JULY 7-13).—We have been fortunate enough to secure the services of Mr. R. J. Bunning as Chief Instructor and Manager of the Club. Flying has been somewhat curtailed this week owing to his slight indisposition, but we hope, however, to be in full swing again on Tuesday. We have made a startling reduction in flying charges this week by bringing the dual charges down to 25*s*. per hour so that we now have a flat rate for all flying dual and solo. This has been possible owing to the increased facilities, and we look for a large increase in flying hours. Local enthusiasm is high and our pupils' list is rapidly being filled up. It is obvious that there are a great many people who would like to fly and have only been prevented through financial reasons. We are trying to solve this problem for them. If occasion arises we can arrange comfortable sleeping accommodation at the Club, and this should prove very attractive to the "flying holiday maker."

NOTTINGHAM AERO CLUB

(JUNE 14-21).—Pilot instructor: Flight-Lieut. Lee-Bateman. Ground engineer: Mr. Warren. Total flying time for week, 26 hrs. 35 mins.

Dual under instruction: Messrs. Starr, McWilliam, Gallimore, Lille Smith, Sail, Nicholson, Thorpe, G. G., Thorpe, H. R., Cudlip, Hallain. Total time dual: 11 hrs. 50 mins. Advanced Dual: Messrs. Hutchinson and Cliff. Soloists: Messrs. Gallimore, Cudlip. Soloists under instruction: Total time, 25 mins. "A" Pilots: Messrs. Warren, Taylor, Kay, F. Granger, Cliff, Hutchinson, Selvey, Shipside, Paul. Total time "A" pilots: 12 hrs. 40 mins. Passengers carried: 14.

FROM THE FLYING SCHOOLS

Brooklands School of Flying, Brooklands Aerodrome

(JULY 1-7).—Flying time, 55 hrs. 35 mins.

The past week has been a very busy one for the School, and our new Moth—G-EBZE—has been continuously in the air. The fine weather has helped

The "Pobjoy Imp": A Parnall 2-seater light biplane, equipped with the 60 h.p. Pobjoy engine, with which an air speed of 100 m.p.h. is obtained. Parts of the Pobjoy engine (which has previously been described in "Flight") are being made by A.C. (Acedes) Cars, Ltd.

considerably to swell the number of pupils of whom the latest are Mr. E. B. H. Wright and Mr. Bjorkvall, from Sweden. We are glad to have one of our old pupils, Mr. Matos, back with us again after several months spent in the workshops of Messrs. Vickers and the Bristol Aeroplane Co.

Mr. Jock Anderson, of the Henderson Flying School, treated us to a hair-raising exhibition of aerobatics on the Henderson-Glenny monoplane. Not only did he loop and spin this machine, but he flew it under the iron bridge not once but three times. It was a marvellous display of airmanship, and "Jock" is to be congratulated on his courage and daring in undertaking to be the first to stunt the new monoplane.

In spite of the gale last Friday, two of our Avros, piloted by Capt. H. D. Davis and Maj. Pickthorn, proceeded to the Andover Pageant, followed by two of our pupils, Mr. H. J. C. Lattey and Mr. F. Lea-Smith, in a Moth. Mr. Lattey put up a fine performance and handled his Moth with great skill in very adverse circumstances.

The School offers its congratulations to an old pupil, Mr. Raymond Quilter, who won a landing competition organised by the Household Brigade Flying Club at Heston last Saturday, just before the finish of the King's Cup Race.

(JULY 8-14).—Flying time, 50 hrs. 40 mins.

We congratulate Mr. C. S. Burney and Mr. F. Lea-Smith on accomplishing their tests for "A" licences in faultless style. Mr. Lea-Smith has wasted no time during his instruction, having joined the School at the end of June and taken his ticket at the end of a fortnight. We think that this proves the great advantage of being able to live on the spot.

The following have joined the school during the past week: Messrs. Bjorkvall, Vickers, Griffiths.

The School has been very busy in all departments preparing for the Aero Show at Olympia, where we have taken a stand.

Brough Flying School, North Sea Aerial and General Transport, Ltd.

(JULY 7-13).—Thanks to the weather of the past week, our flying time for that period totals nearly 96 hours, of which all but seven hours was carried out on the land machine side. The low total for seaplanes is due to the fact that only two officers were here for training—Flying Officers Martin and Mayer. Flying Officer Mayer completed one quarter's training on Wednesday, and Flying Officer Martin four quarters on Friday.

On the land machine side, Flight Lieut. Lock, Flying Officers Williams, Dick, Brewster, Flynn and Pilot Officer Curtice received 4 hrs. 55 mins. dual on "Darts" and carried out 51 hrs. 30 mins. solo flying. Flying Officer Brewster completed two quarters' training on Thursday and Flying Officer Flynn four quarters' on Saturday. Pilot Officer Curtice completed his course of 'ab initio' training on Friday.

Pilot Officers Higgins, S. Clarke, W. Clarke, Buck, Wood, Hay, and Stanley received 16 hrs. 15 mins. dual on "Bluebirds" and carried out 8 hrs. 40 mins. solo flying.

Phillips and Powis School of Flying, Reading Aerodrome

(JULY 5-11).—Flying time: 29 hrs. 10 mins. Instructors: Flight-Officer R. T. Shepherd, Mr. H. G. B. Michelmore.

Notes.—Our first Indian pupil, Mr. J. C. Sahney, has joined the School this week, and is making very satisfactory progress.

Mr. A. R. Lea successfully passed his test for his "A" licence.

An R.A.F. Squadron from Farnborough used our aerodrome this week for manœuvres, and reported very favourably on the site.

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Madrid to Lisbon by Autogiro

SENOR RAMBAUD, Spanish Pilot of the Cierva Autogiro, made a non-stop flight on July 11 from Madrid to Lisbon in four hours against a head wind all the way. The distance along the Tagus, which was the route chosen, is about 350 miles.

Western Australian Airways

THE *Airways Bulletin*, published from Perth, W. Australia, reports flying statistics to May 31, 1929, as follows:—Passengers carried (Perth-Derby route), 6,328; passengers carried (taxi and joy-ride), 6,546; machine flights, 8,474; miles flown, 1,180,739; letters carried (to April 30), 1,464,999; freight carried (lbs.), 227,032.

The month of May was one of the busiest for all hands connected with the service, since an air route was inaugurated in Western Australia. After the three D.H.50 machines were released from the search for the "Southern Cross," it became necessary to submit them to a thorough overhaul before they were again put into commission on the regular air route. It is not usual to have three machines in the ground engineers' hands at once, but no variation from the rule of the service—that nothing should come before SAFETY—could be thought of, and so the work had to go on. On top of that came the assembly and testing of the new D.H. "Hercules" air liners for use on the new Perth-Adelaide Airway.

Geneva Conference on Red Cross Aircraft

THE International Red Cross Diplomatic Conference at Geneva has adopted a new article dealing with the use of aeroplanes for Red Cross work during war, states a *Times* correspondent.

The conference had before it a text drawn up by a sub-committee specially appointed to consider this problem. Before dealing with this, however, it discussed a proposal by the Japanese delegation to limit the altitude of Red Cross aeroplanes. France had already proposed to fix this at 1,000 m. in order to avoid the use of these machines for observation purposes. The conference decided that this was a question of technical detail which need not be dealt with at present. The final text adopted was as follows:—(1) Aeroplanes used for medical purposes should enjoy the protection of the Convention on condition that they be exclusively reserved for the transport of sick and wounded. (2) Aeroplanes must be painted white, and clearly marked with the distinctive sign provided for in Article 18 (a red cross), in addition to the national colours on their lower and upper surfaces. (3) Except in case of special and express permission it is formally forbidden to fly over the line of fire, as well as over the zone situated in front of the chief medical clearing station, or over any fortification whatever. (4) Medical aeroplanes must obey every summons to land. (5) In case of unintentional or forced landing on enemy territory, the sick and wounded, as well as the personnel and material, including the aeroplane, continue to benefit by the provisions of the present Convention. (6) The pilot, mechanics, and wireless operators captured will be surrendered on condition that they give their *parole* not to serve until the end of hostilities in any but a medical formation.

A sub-committee was appointed to accord this text with the articles previously adopted.

D.H. Items

No less than 16 Gipsy-engined Moths were starters in the King's Cup Race and 14 of them finished. We understand that neither of the two retirements was due to mechanical failure of any sort. The present position of the "sealed" Gipsy Engine Reliability Tour is that the engine has completed 485 hours at a speed which has covered well over 44,000 miles. Immediate deliveries of D.H. Gipsy engines can be made with service facilities throughout the world.

Atlantic Flight Failures

Two single-engined machines attempted to fly the Atlantic from east to west last week and both failed. One was an Amiot aircraft, *Marshal Pilsudski* (600-h.p. engine), flown by Majors Idzikowski and Kabala, and the other was a Brêguet machine, *The Question Mark* (600 h.p. engine), flown by the French airmen, Capt. D. Costes and M. Bellonte. The machines left Le Bourget very early on July 13 within an hour of each other. Owing to the French official ban on Atlantic flights Capt. Costes had previously stated that Tokio was his destination, but at the last moment he sent to the French Air Ministry a letter in which he excused himself for taking-off for a "prohibited" destination. Both machines were sighted during the early stages of the flight towards the Azores, and the French machine was in wireless communication with Paris during the day. At 6.15 p.m. the latter turned back when close to the Azores owing to bad weather and strong head winds, and after flying through the night it landed at Villacoublay at 9.25 a.m., having been flying for 28 hours, and covered a distance of 1,650 miles. The Polish machine also reported its intention of landing owing to difficulties. This was made on the Graciosa island in the Azores, and resulted in a crash, in which Major Idzikowski was killed and his companion slightly injured. This Polish attempt on the Atlantic was the second of its kind, and was financed by the Polish Government. Capt. D. Costes, the French pilot, flew the South Atlantic some time ago, also in a Breguet machine, accompanied by Lieut. Le Brix, and he followed it up with a long flight through America and over Europe from the East.

Johannesburg-Berlin Flight

MR. FILSINGER, an American, left Johannesburg recently for Berlin in a D.H. Moth, piloted by Mr. Bentley. The flight is to be made in easy stages.

Air Mail to India

THE Indian air mail, consisting of 18 bags of letters, weighing over a quarter of a ton, left Croydon aerodrome in an Argosy air-liner of the Imperial Airways last Saturday. In addition to mails, the Argosy carried ten passengers, including Sir Samuel Hoare, the former Secretary for Air, and a large quantity of freight consigned to Ceylon, Calcutta and Rangoon. The air mail is due in India, after its 5,000-mile flight, on Saturday.

Flying in Ireland

FLYING in Ireland is rapidly increasing in popularity. Among the air enthusiasts is the Hon. Arthur E. Guinness, who, in addition to erecting an aerodrome on the upper reaches of the Corrib, in front of his residence at Ashford, has just received the permission of Ballinrobe Race Committee to erect another aerodrome there.

Extensive Aerial Survey for British Columbia

IN connection with the present survey programme along the route of the Pacific Great Eastern Railway, the British Columbia Government proposes to utilise aircraft in order to conduct a photographic survey of 10,000 square miles of territory. Two Royal Canadian Air Force cabin monoplanes will be loaned by the Canadian Government. At least one, and perhaps two, commercial 'planes operating in Vancouver will assist the R.C.A.F. machines. A total of $400,000 is to be spent making a survey of the natural resources of 10,000 square miles.

Seaplane Harbour for Toronto

TORONTO'S ambition to have one of the finest seaplane and landplane ports on the Continent has reached a step forward with the announcement that an application of the Toronto Harbour Commissioners for a grant of £20,000 to cover the initial stages of construction of a seaplane harbour on Toronto Island was approved by the Board of Control.

Seaplane Base on the Humber

NEGOTIATIONS have been completed between the Hull Corporation and the War Office for the leasing of land for the establishment of a seaplane base on the River Humber. The offer of the National Flying Services of a rental of £350 per annum for a portion of the municipal aerodrome site at Hedon was accepted by the aerodrome committee.

Airport of Malmoe

THE city of Malmoe, the third in size of the Swedish cities, has now become the metropolis of Scandinavian aviation. The Bulltofta aerodrome near Malmoe is the centre of the air lines to the different parts of Europe, and it is the headquarters of the night air mail service which has been carried on with great success for some time. Bulltofta has now been equipped with all the latest technical contrivances of a modern air port.

Customs Authority Granted to Heston

THE Air Ministry, in a notice to airmen (No. 38 of 1929), states that Heston Aerodrome, Hounslow, Middlesex, is, with the concurrence of the Commissioners of Customs and Excise, approved as a Customs Aerodrome under paragraph 2 of Schedule VIII to the Air Navigation (Consolidation) Order, 1923. The necessary directions under the Order will be published in due course as the Air Navigation Directions, 1929 (A.N.D. 4F), and will now be in operation until August 3.

Still going strong! The D.H. Gipsy Moth, with sealed engine, which has now done 485 hours (or 44,000 miles) with only external routine attention.

THE ROYAL AIR FORCE

London Gazette, July 9, 1929.

General Duties Branch

The following are granted short service commns. as Pilot Officers on probation with effect from and with seniority of June 28:—G. E. Agard-Butler, N. Alexander, F. C. Allen, C. A. Ball, G. Bearne, G. Calvert, N. J. Capper, D. I. Carlyle, I. A. Critchley, C. H. Glover, D. H. A. Golege-Steel, W. E. Grant, D. C. Harrison, W. J. Hodge, A. H. Houghton, G. M. Ievers, F. J. B. Keast, D. W. Lydall, I. L. S. McNicol, C. W. Marriott, T. G. Mellor, C. E. Morse, J. T. Mynors, B. Paddon, H. G. J. Purcell, N. Stratton, J. M. Waddell, G. N. Warrington, G. E. S. Williams, S. N. Wiltshire.

The following pilot officers are promoted to rank of Flying Officer: A. D. Bennett (with seniority of March 2) (March 7); N. F. V. Henkel (June 8); D. J. Waghorn, N. A. Tait, W. H. Hutton, J. R. H. Pott, W. K. Beisiegel (June 17); H. Bailey, V. S. Bowling, N. W. Creasy, E. D. Elliott, W. R. Tope (June 30).

Flying Officer A. W. Elias takes rank and precedence as if his appointment as Flying Officer bore date Jan. 31, 1927—reduction takes effect from June 20, 1929; Flying Officer M. H. Clare takes rank and precedence as if his appointment as Flying Officer bore date May 9, 1929—reduction takes effect from May 16, 1929; Pilot Officer H. R. Dale takes rank and precedence as if his appointment as Pilot Officer bore date Feb. 22, 1929, immediately following Pilot Officer A. F. C. Booth on the gradation list—reduction takes effect from May 24, 1929.

Flying Officer E. Whittlesea, M.B.E., is placed on retired list (July 6).

Flying Officer H. J. Usher is placed on retired list on account of ill-health (July 10).

The following Flying Officers are transferred to Reserve (July 8):—

CLASS A.—C. H. Morgan, J. E. Davies, R. W. Steele, A. J. Thompson, W. B. Gray, E. L. Leader, W. A. Cooke.

CLASS C.—L. A. Egglesfield, H. Walker.

Flying Officer B. B. Dowling (Lt. Manch. R. R.A.R.O.) relinquishes his short service commn. on account of ill-health (July 8).

The short service commns. of the following Pilot Officers on probation are terminated on cessation of duty:—I. M. L. Kat Ferreira (June 29); E. G. Hucker (July 6).

Pilot Officer on probation C. H. Robbins is dismissed the Service by sentence of General Court Martial (June 29).

Memorandum

The permission granted to G. H. Allender to retain the honorary rank of Sec. Lt. is withdrawn on his conviction by the Civil Power (May 3).

RESERVE OF AIR FORCE OFFICERS

General Duties Branch

The following are granted commns. in Class A.A. (ii) as Pilot Officers on probation:—R. G. Shaw (June 21); W. Clarke (June 24); I. B. Sherring, L. Swan (June 26); K. Shenstone, E. S. Kennedy (June 27).

The following Pilot Officers on probation are confirmed in rank:—J. G. Naz, E. W. Seymour-Hosley (June 29); J. L. Browne, W. W. L. Jones (July 2); J. W. Carmichael (July 9).

Pilot Officer J. A. Hall of the Special Reserve is promoted to rank of Flying Officer (June 21).

The following are transferred from Class A to Class C:—Flight Lt. R. A. Birkbeck, D.F.C. (May 12); Flying Officer G. C. Lugg (March 13).

The following Flying Officers relinquish their commns. on account of ill-health and are permitted to retain their rank:—S. A. Lane (July 10); D. H. B. Clark (July 3).

Flying Officer A. L. Monger is dismissed the Service by sentence of General Court Martial (June 6).

ROYAL AIR FORCE INTELLIGENCE

Appointments—The following appointments in the Royal Air Force are notified:—

General Duties Branch

Group-Captain: H. R. Busteed, O.B.E., A.F.C., to R.A.F. Reception Depot, West Drayton, to command; 4.7.29.

Squadron-Leader: F. E. Hellyer, O.B.E., to Headquarters, Coastal Area; 8.7.29.

Flight-Lieuts.: H. G. P. Ovenden, to No. 216 Sqdn., Middle East; 17.6.29. J. W. Colquhoun, to H.M.S. *Hermes*; 13.5.29. C. E. H. Allen, D.F.C., to Cambridge University Air Sqdn.; 8.7.29. C. E. Maitland, D.F.C., to Experimental Section, Royal Aircraft Estabt., S. Farnborough; 24.6.29. H. A. L. Pattison, to Royal Air Force College, Cranwell; 29.6.29.

Flying Officers: W. J. Coadwell, D.S.M., to Aircraft Depot, Iraq; 5.6.29. W. G. Campbell, to Home Aircraft Depot, Henlow; 6.6.29. D. G. Walker, to Home Aircraft Depot, Henlow; 25.6.29. J. H. Pool, to Home Aircraft Depot, Henlow; 3.7.29. H. M. S Wright, J. M. Cohu, A. W. B. McDonald and G. B. M. Rhind, all to Cambridge University Air Sqdn.; 8.7.29. D. D. M. Eastwood, to No. 4 Stores Depot, Ruislip; 6.6.29. (Hon. Flight-Lieut.) L. P. Winters, to No. 501 Sqdn., Filton; 3.7.29. D. J. Waghorn, to No. 408 (Fleet Fighter) Flight; 21.6.29. C. H. Johnson, to R.A.F.M.T. Depot, Shrewsbury; 15.7.29. C. W. L. Trusk, A.F.C., to Home Aircraft Depot, Henlow; 1.7.29. R. J. Carvell, to Home Aircraft Depot, Henlow; 8.6.29. P. C. Fair, to No. 446 (Fleet Spotter Reconnaissance) Flight; 5.7.29. G. N. S. Lane, to H.Q., Coastal Area; 1.7.29.

Pilot Officers: D. R. S. Freestone, to No. 3 Flying Training Schl., Grantham; 17.6.29, on appointment to a Permanent Commn. (on probation). E. Coleman, D.F.M., to Royal Air Force Coll., Cranwell; 17.6.29, on appointment to a Permanent Commn. (on probation). H. E. Dicken, to No. 35 Sqdn., Bircham Newton; 17.6.29, on appointment to a Permanent Commn. (on probation). P. J. Connolly, to No. 47 Sqdn., Middle East; 19.6.29. P. J. J. Cullinan, G. A. E. Harkness, and R. Louis, to No. 70 Sqdn., Iraq; 13.6.29. J. C. Harcombe, to No. 55 Sqdn., Iraq; 13.6.29. E. C. Passmore, to No. 30 Sqdn., Iraq; 13.6.29. J. R. Robins, to No. 84 Sqdn., Iraq; 13.6.29.

Stores Branch

Flight-Lieut.: H. J. Barnham, to Station H.Q., Duxford; 14.6.29.

Flying Officer: B. E. Essex, to R.A.F. Base, Malta; 5.7.29.

Accountant Branch

Flying Officer: R. J. Wishlade, to R.A.F. Depot, Uxbridge; 1.7.29.

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IN PARLIAMENT

Indian Air Mail

MR. LEES SMITH, on July 8, in reply to Mr. Day, said the number of letters sent is not recorded. The total weight of correspondence sent to India by air since the service began is about 5,000 lbs.

Airship R 100

MR. MONTAGUE, in reply to Mr. Day, said the inflation of H.M. Airship R 100 should begin towards the end of this month. Allowing approximately two months for the process of inflation and carrying out of shed trials, the airship should take the air about the end of September.

Gas Attacks and the Protection of Civil Population

BRIGADIER-GENERAL CLIFTON BROWN, on July 9, asked the Prime Minister whether the committee which has been considering plans for the protection of the civil population from attack from the air by poison gas, has yet evolved a scheme; and, if so, whether the British Red Cross and local authorities are taking steps to operate it in case of necessity?

Mr. J. Ramsay MacDonald: In view of the recent ratification of the Geneva Gas Protocol of 1925 by most of the important European States, including this country, I do not think this is a moment to press the local authorities to develop plans for the protection of the civil population against gas attack. Much preparatory work had, however, been done by the Committee of Imperial Defence upon this problem prior to the ratification of the Protocol and that work will not be thrown away if, unfortunately, a situation should hereafter arise requiring as a measure of prudence the development of plans for this purpose.

Geneva Protocol and Poison Gases

MR. A. HENDERSON, on July 10, in reply to Commander Bellairs, said the following European countries have not ratified or acceded to the Geneva Protocol prohibiting the use of poison gases: Albania, Bulgaria, Czechoslovakia, Denmark, Estonia, Finland, Great Britain, Irish Free State, Greece, Hungary, Latvia, Lithuania, Luxemburg, The Netherlands, Norway, Portugal, Roumania, Spain, Sweden, Switzerland. Of the above, Great Britain, the Irish Free State and Finland have undertaken to ratify or accede as soon as possible. Soviet Russia was not in the list.

Light Aeroplane Clubs and Subsidy

MR. MANDER asked the Under-Secretary of State for Air whether it is the intention of the Government to continue the payment of subsidies to light aeroplane clubs after the expiration of the present subsidy in April, 1930?

Mr. Montague: The agreements with the light aeroplane clubs, the earliest of which expires on July 30, 1930, were based on the principle that the clubs required a subsidy for three years, at the end of which period it was expected that they would be self-supporting. I hope this expectation may be realised, but in any case regard it as premature to discuss what action should be taken in the hypothetical event of its being disappointed.

Aircraft Examinations

CAPT. BALFOUR asked whether in the arrangements which have been come to whereby civil aircraft owners are obliged to have the examination of aircraft for renewal of certificates of airworthiness carried out, not by Air Ministry officials, but by officials of a private concern named the British Aviation Insurance Group, aircraft owners will have the option of still having such examination carried out by Air Ministry officials if they so desire?

Mr. Montague: Yes, they certainly have that option. There is no obligation whatever upon owners of private civil aircraft to have their aeroplanes inspected by the British Aviation Insurance Group under the arrangement made with that body in connection with the renewal of certificates of airworthiness, and it rests entirely with each owner whether he will have his aircraft inspected under that arrangement or as hitherto, by Air Ministry officials.

Capt. Balfour asked whether the principle of the Air Ministry authorising private concerns to carry out the necessary examination of civil aircraft, as required for the renewal of a certificate of airworthiness under the Air Navigation Act, is to be extended to applicants other than the British Aviation Insurance Group; and, if so, will the qualifications required by the Air Ministry before the granting of such powers to a civil concern be defined and published by the Air Ministry?

Mr. Montague: As regards the first part of the question, the position is that two bodies, including the one mentioned, are being accepted as competent to make recommendations for the purposes of the renewal of certificates of airworthiness for privately-owned aircraft.

The answer to the second part of the question is in the negative, but applications from other responsible bodies possessing competent inspection organisations will receive consideration.

Military Aeroplanes and Civilians

MR. MONTAGUE, in answer to Capt. Crookshank, said the use of military aeroplanes by civilians other than those connected with the Air Ministry is regulated in accordance with paragraph 797 of the King's Regulations for the Royal Air Force, which provides *inter alia* for the conveyance—I quote the actual text of the Regulations—of "persons of distinction in the public service of any part of the British Empire or of any friendly Power"—in cases in which the responsible authority "is satisfied that the public interest would be promoted by the grant of flying facilities." In this country such flights are only authorised by the Air Ministry, while overseas the personal authority of an air or other officer commanding is required. No charge is made for such use.

Long-Distance Flying-Boat Cruises

CAPT. BALFOUR asked whether the Air Ministry will consider the possibility of extending the policy of long-distance flying-boat cruises so as to enable a flight of Royal Air Force flying-boats to visit South American ports in a similar manner to the visits paid to these ports by naval craft; and whether such a cruise could be considered so as to allow of such boats visiting Buenos Aires at the time of the proposed Buenos Aires British Empire trade exhibition during November, 1930, to February, 1931?

Mr. Montague: Yes, it is the Air Ministry's intention to consider the possibility referred to as and when aircraft suitable for the purpose become available, but I cannot give any undertaking that they will be so available as early as November, 1930.

AIR MINISTRY REPORT ON THE CHANNEL DISASTER.

THE Air Ministry issued on July 15 their report on the formal investigation into the accident on June 17 to the cross-Channel aircraft G-EBMT, known as the *City of Ottawa*, which caused the loss of seven passengers. We publish for the present a very brief summary of some important recommendations contained in the report, and we hope to publish a more complete account in a later issue of FLIGHT. This inquiry was held by Sir Arthur Colefax and his report is also signed by Air Commodore J. G. Weir and Mr. James Swinburne, who were appointed by the Ministry as assessors. Their report attaches no blame to the pilot or Imperial Airways for the disaster, and the mishap to the starboard engine which caused the forced descent was described as of a kind which was unavoidable, but it is recommended that it should be a condition of every certificate of airworthiness for aircraft not specially designed to alight safely on water and without sufficient reserve of engine power in the event of one engine failing, that they should not be used in public transport for carrying passengers abroad.

It would have been more satisfactory, continues the report, had Imperial Airways, Ltd., required pilots of passenger-carrying aircraft who were unable, when one engine failed, to maintain height with full load, to refer to Croydon and obtain sanction for a departure from the Channel crossing regulations of the company. The Court was told that such a course would be practicable and that the company would not be averse to it.

After the mishap to the starboard engine land could have been reached, if at all, only by opening out the port engine. No blame attached to the pilot for not taking the risks involved in increasing the r.p.m. of the port engine beyond normal cruising speed.

Two matters relating to the lifebelts called for consideration; one being whether a lifebelt of sufficient buoyancy but not too large to make it undesirable for the wearer to inflate it while still in the cabin, could not be devised, and also whether some simpler means could not be designed for releasing the compressed air to inflate the belt if the present one continued to be provided.

There was no evidence which would warrant the conclusion that any life was lost by reason of a belt not being in proper order, or because of its design, or by reason of the insufficiency of instruction on use which the passengers received.

After a very careful consideration of the evidence, which dealt exhaustively with the manufacture of the engine bearing studs which fractured, and the suitability of the steel used therein, the Court was definitely of the opinion that nothing that human foresight could have done in providing against the primary cause of the starboard engine becoming relatively useless was omitted either on the part of Messrs. D. Napier and Son, Ltd., or their personnel.

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Mr. J. R. Cautley

MR. J. R. CAUTLEY, who has long been associated with the Bendix Brake Co., and has had considerable experience of brake problems of all descriptions, will visit England for the exhibition. Of recent years he has devoted his attention to aeroplane brakes and he has been responsible for the development of the Bendix aircraft brake and wheel in the United States. His present visit is being made at the request of Mr. Herbert Clark, managing director of Bendix-Perrot Brakes, Ltd., Birmingham. Letters to Mr. Cautley should be addressed: c/o Bendix-Perrot Brakes, Ltd., Westwood Road, Witton, Birmingham.

Silvertown Lubricants, Ltd.

MR. C. A. FEATHERSTONE, Mr Wm. Lee and Mr. J. Russell Knowles have recently been elected to the Board of Silvertown Lubricants, Ltd. They have been associated with the company since its formation; Mr. Featherstone as Secretary, Mr. Lee as Chief Chemist and Mr. Knowles on the Technical and Sales Staff, and were previously for many years with the firm which preceded the company.

Accurate Recording Instrument Co. Ltd.

Dr. J. D. BENJAFIELD, the West End bacteriologist, who has scored many successes in motor-racing events at home and abroad, and who is a member of the Committee of the British Racing Drivers' Club, has just joined the Board of The Accurate Recording Instrument Co. Ltd., of Manor Road, Teddington. This firm of precision instrument manufacturers is embarking upon the production of a device patented by Dr. Benjafield for controlling the temperature of the water in the radiator.

PUBLICATIONS RECEIVED

This Bondage. By Commander Bernard Acworth. John Murray, 50A, Albemarle Street, London, W.1. Price 7s. 6d. net.

Observations of Upper Air Currents at Apia, Western Samoa (Second Series). By A. Thomson. Department of Scientific and Industrial Research, New Zealand. W. A. G. Skinner, Government Printer, Wellington, New Zealand.

Aeronautical Research Committee Reports and Memoranda: No. 1194 (*Ae.* 356).—An Investigation of Fluid Flow in Two Dimensions. By A. Thom. November, 1928. Price 1s. net. H.M. Stationery Office, Kingsway, London, W.C.2.

The Countryman. July, 1929. *Vol. III. No.* 2. J. W. Robertson Scott, Idbury, Kingham, Oxford.

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IMPORTS AND EXPORTS

AEROPLANES, airships, balloons and parts thereof (not shown separately before 1910.)

For 1910 and 1911 figures see FLIGHT for January 25, 1912.
For 1912 and 1913, see FLIGHT for January 17, 1914.
For 1914, see FLIGHT for January 15, 1915, and so on yearly, the figures for 1927 being given in FLIGHT, January 19, 1928.

	Imports.		Exports.		Re-exports.	
	1928.	1929.	1928.	1929.	1928.	1929.
	£	£	£	£	£	£
Jan.	.. 1,220	2,852	157,598	74,307	330	100
Feb.	.. 1,772	6,532	118,622	195,369	345	2
March	.. 4,805	1,210	125,901	204,664	1,307	902
April	.. 2,904	5,816	134,126	186,477	3	115
May	.. 2,513	4,706	118,804	243,549	640	1,243
June	.. 5,916	9,304	86,245	144,817	1,317	750
	19,130	30,420	741,296	1,049,183	3,942	2,302

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HELI-AIRCRAFT, LTD., 116, Clifton St., Cardiff.—Capital £1,000, in £1 shares. Objects: Manufacturers of and dealers in aircraft of all descriptions, aerodrome and garage proprietors, makers of and dealers in engines and engine parts and accessories of all kinds, and things appertaining to the making of complete aircraft, motor vehicles and the like, etc.

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SIDARBLEN ENGINES, LTD., 4, Old Burlington Street, W.1.—Capital £500, in 450 ordinary and 50 founders' shares of £1 each. Acquire any inventions relating to engines, and to carry on the business of mechanical, aeronautical and electrical engineers, etc. Directors: A. A. Sidney, 22, Barnes Road, Croydon, Surrey; M. O. Darby, Regent House, Kingsway, W.C.2; Lt.-Col. J. Barrett-Lennard, Regent House, Kingsway, W.C.2.

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AERONAUTICAL PATENT SPECIFICATIONS

(*Abbreviations*: Cyl. = cylinder; i.c. = internal combustion; m. = motor. The numbers in brackets are those under which the Specifications will be printed and abridged, etc.)

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8,361. A. P. THURSTON. Means for controlling aircraft, etc. (314,165.)
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9,306. D. R. DAVIS. Screw propeller. (287,879.)
10,215. S. E. SAUNDERS and H. KNOWLER. Means for regulating flow of cooling-air through aircraft radiators. (314,148.)
26,388. E. RUESS Frames for rigid airships. (314,276.)

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